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FAA ltr 26 Apr 1977

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Report No. FAA-SS-73-11-3

(1) 48

SST Technology
Follow-On Program—Phase II
NOISE SUPPRESSOR/NOZZLE DEVELOPMENT
VOLUME III

NOISE TECHNOLOGY—BACKUP DATA REPORT

AD B 004730

AD No. _____
DDC FILE COPY

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P.O. Box 3707
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D6-42444

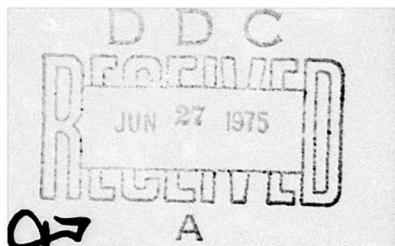
March 1975

FINAL REPORT

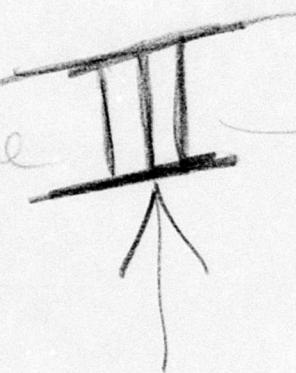
Task III

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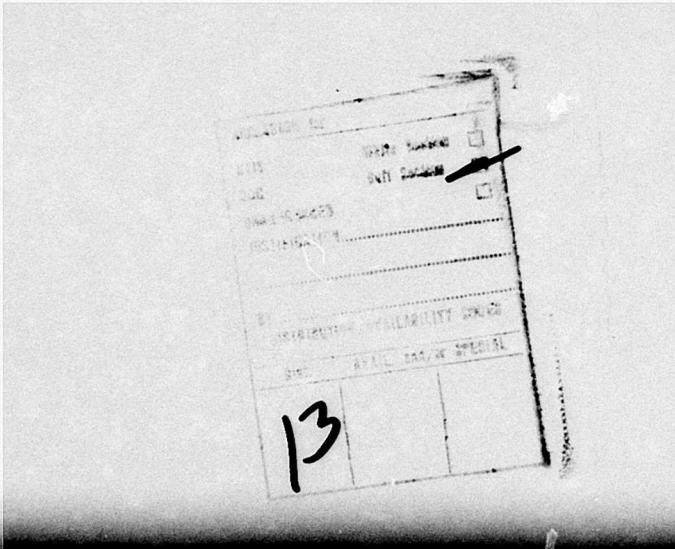
Prepared for
FEDERAL AVIATION ADMINISTRATION
Supersonic Transport Office
800 Independence Avenue, S.W.
Washington, D.C. 20590



Volume



The contents of this report reflect the views of the Boeing Commercial Airplane Company, which is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policy of the Department of Transportation. This report does not constitute a standard, specification, or regulation.



TECHNICAL REPORT STANDARD TITLE PAGE

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6. Author(s) J. ATVARIS, J.D. NUHSE, C.P. WRIGHT, C.D. SIMCOX		7. Performing Organization Code
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12. Supplementary Notes S. Blatt, DOT/SST Technical Monitor		13. Type of Report and Period Covered <i>FINAL REPORT TASK III</i>
14. Sponsoring Agency Code <i>be referred to other agencies only if requested</i>		15. Abstract <p>Jet noise suppression technology was studied in this program and reported in Volume II of this document. The data base for the technology studies consisted of static far field noise signatures and jet noise source location measurements for a systematic set of multtube nozzles, with and without ejectors. Acoustic results were complemented by flow profile data to better understand the noise generation and suppression mechanisms. A representative set of test configurations were chosen for which the basic data has been compiled in this report in a standardized format to be readily available to those researchers who may desire to study the data behind the discussions in Volume II. Because of limitations of space not all of the available data could be included. The data presented in this report consists of sound power spectra, sound pressure spectra, directivity patterns, extrapolated perceived noise level characteristics, jet noise source location data and jet flow profiles.</p>
17. Key Words JET NOISE MULTITUBE JETS EJECTORS EJECTOR/SUPPRESSORS FLOW PROFILES		18. Distribution Statement Approved for U.S. Government only. This document is exempted from public availability because of restrictions imposed by the Export Control Act. Transmittal of this document outside the U.S. Government must have prior approval of the Supersonic Transport Office.
19. Security Classif. (of this report) UNCLASSIFIED	20. Security Classif. (of this page) UNCLASSIFIED	21. No. of Pages 418
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PREFACE

This is one of a series of final reports on noise and propulsion technology submitted by the Boeing Commercial Airplane Company, Seattle, Washington, 98124, in fulfillment of Task III of Department of Transportation Contract DOT-FA-72WA-2893, dated 1 February 1972.

To benefit utilization of technical data developed by the noise suppressor and nozzle development program, the final report is divided into 10 volumes covering key technology areas and a summary of total program results. The 10 volumes are issued under the master title, "Noise Suppressor/Nozzle Development." Detailed volume breakdown is as follows:

		Report No.
Volume I	- Program Summary	FAA-SS-73-11-1
Volume II	- Noise Technology	FAA-SS-73-11-2
Volume III	- Noise Technology—Backup Data Report	FAA-SS-73-11-3
Volume IV	- Performance Technology Summary	FAA-SS-73-11-4
Volume V	- Performance Technology—The Effect of Initial Jet Conditions on a 2-D Constant Area Ejector	FAA-SS-73-11-5
Volume VI	- Performance Technology—Thrust and Flow Characteristics of a Reference Multitube Nozzle With Ejector	FAA-SS-73-11-6
Volume VII	- Performance Technology—A Guide to Multitube Suppressor Nozzle Static Performance: Trends and Trades	FAA-SS-73-11-7
Volume VIII	- Performance Technology—Multitube Suppressor/Ejector Interaction Effects on Static Performance (Ambient and 1150°F Jet Temperature)	FAA-SS-73-11-8
Volume IX	- Performance Technology—Analysis of the Low-Speed Performance of Multitube Suppressor/Ejector Nozzles (0-167 kn)	FAA-SS-73-11-9
Volume X	- Advanced Suppressor Concepts and Full-Scale Tests	FAA-SS-73-11-10

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CONTENTS

	PAGE
1.0 INTRODUCTION	1
2.0 TEST DATA	2

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SYMBOLS AND ABBREVIATIONS

A_8	Nozzle exit area
D_E	Equivalent flow area conical nozzle diameter
Hz	Hertz (frequency)
HNTF	Hot Nozzle Test Facility
NPR	Nozzle pressure ratio
OASPL	Overall sound pressure level
P_{amb}	Ambient pressure
PNL	Perceived noise level
PNdB	Perceived noise in units of decibels
PWL	Sound power level
R.H.	Relative humidity
SPL	Sound pressure level
T_{amb}	Ambient temperature
T_T	Total temperature
V_J	Jet velocity
μ Bar	micro-Bar (pressure)
x	distance

1.0 INTRODUCTION

The model scale jet noise technology results were analyzed and discussed in Volume II of this report. The large quantity of test data that was acquired for the purpose of the technology studies could not be documented adequately together with the final analysis in one book. Therefore, a separate test data report has been prepared to preserve a representative cross-section of test data for those investigators that require to examine in more detail the information that formed the foundation for Volume II. Even with this approach 100% documentation of test data is beyond the scope of this report.

It was decided to arrange the test data in order of nozzle configurations. For each nozzle configuration a hardware and test parameter description is given, followed by key examples of PWL, SPL and PNL spectra, beam patterns, "normalized" noise levels, and noise suppression values. SPL and PNL spectra are presented for only two angles, 110° and 130°, which are representative of peak premerged and postmerged noise respectively. This data is then followed by noise source location results and flow profile curves for those configurations where such data was acquired.

2.0 TEST DATA

Test data for the following model scale nozzle configurations appears in this data report.

Nozzle	Description	Page
4.16" RC	4.16 Inch Diameter, Round Convergent Nozzle	6
6" RC	6 Inch Diameter, Round Convergent Nozzle	27
37T-3.3AR-CPA-RT/RC	37 Tubes, 3.3 Area Ratio, Close-Packed Array, Round Tubes with Round Convergent Ends	34
7T-3.3AR-CPA-ET/RC	7 Tubes, 3.3 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends	58
19T-3.3AR-CPA-ET/RC	19 Tubes, 3.3 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends	83
37T-3.3AR-CPA-ET/RC	37 Tubes, 3.3 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends	108
37T-3.3AR-CPA-ET/RC w/3.1AR EJECTOR	37 Tubes, 3.3 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends with 3.1 Area Ratio Ejector, $L/D_E = 2$ Long	121
61T-3.3AR-CPA-ET/RC	61 Tubes, 3.3 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends	143
37T-2.75AR-CPA-ET/RC	37 Tubes, 2.75 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends	168
37T-4.5AR-CPA-ET/RC	37 Tubes, 4.5 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends	194
37T-6.0AR-CPA-ET/RC	37 Tubes, 6.0 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends	218
37T-3.3AR-RA-RT/NC	37 Tubes, 3.3 Area Ratio, Radial Arrangement, Round Tubes with Non-Convergent Ends	243

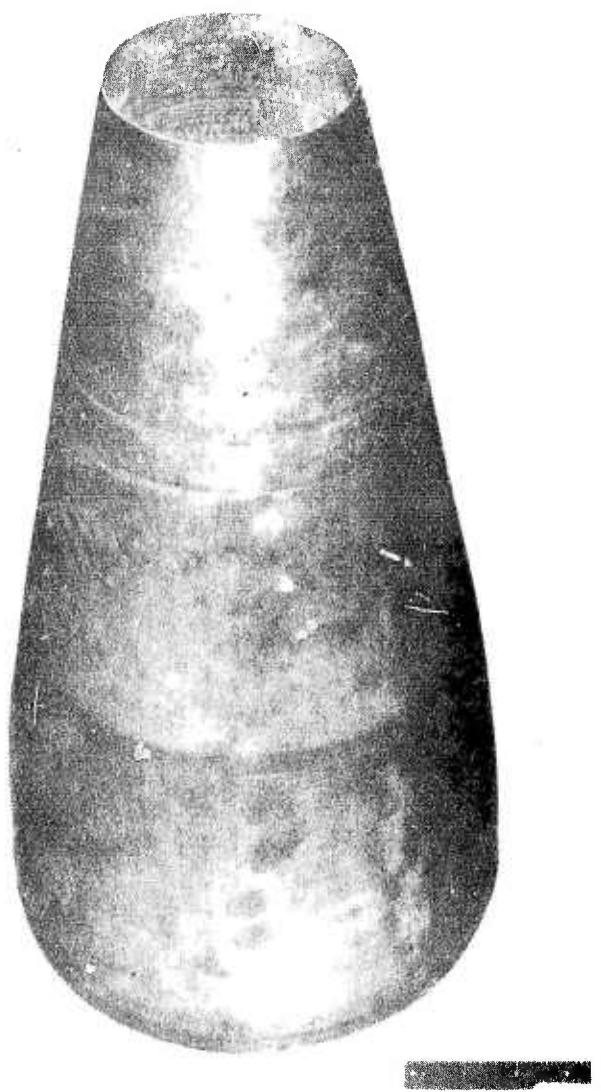
Nozzle	Description	Page
37T-4.5AR-RA-ET/RC	37 Tubes, 4.5 Area Ratio, Radial Arrangement, Elliptical Tubes with Round Convergent Ends	268
31T-2.75AR-RA-ET/RC	31 Tubes, 2.75 Area Ratio, Radial Arrangement, Elliptical Tubes with Round Convergent Ends	287
31T-2.75AR-RA-ET/RC w/2.6AR-EJECTOR	31 Tubes, 2.75 Area Ratio, Radial Arrangement, Elliptical Tubes with Round Convergent Ends with 2.6 Area Ratio Ejector, $L/D_E = 2$ Long	299
31T-2.75AR-RA-ET/RC w/3.1AR-EJECTOR	31 Tubes, 2.75 Area Ratio, Radial Arrangement, Elliptical Tubes with Round Convergent Ends with 3.1 Area Ratio Ejector, $L/D_E = 2$ Long	309
31T-2.75AR-RA-ET/RC w/3.7AR-EJECTOR	31 Tubes, 2.75 Area Ratio, Radial Arrangement, Elliptical Tubes with Round Convergent Ends with 3.7 Area Ratio Ejector, $L/D_E = 2$ Long	319
42T/Annulus-3.3AR-CPA-ET/RC	42 Tubes with Annulus and Plug, 3.3 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends, 0.383" Wide Annulus	329
42T/Annulus-3.0AR-CPA-ET/RC	42 Tubes with Annulus and Plug, 3.0 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends, 0.533" Wide Annulus	352
42T/Annulus-2.6AR-CPA-ET/RC	42 Tubes with Annulus and Plug, 2.6 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends, 0.8" Wide Annulus	362
42T/Annulus-2.4AR-CPA-ET/RC	42 Tubes with Annulus and Plug, 2.4 Area Ratio, Close-Packed Array, Elliptical Tubes with Round Convergent Ends, 1.067" Wide Annulus	372

Nozzle	Description	Page
61T-3.1AR-CPA-RT/NC	61 Tubes, 3.1 Area Ratio, Close-Packed Array, Round Tubes with Non-Convergent Ends	392
61T(Canted)-3.1AR-CPA-RT/NC	61 Tubes with the Outer Row of 24 Tubes Canted Outwards, 3.1 Area Ratio, Close-Packed Array, Round Tubes with Non-Convergent Ends	401
85T-3.1AR-CPA-RT/NC	85 Tubes, 3.1 Area Ratio, Close-Packed Array, Round Tubes with Non-Convergent Ends	410

Typically the noise data for each test configuration is arranged in the following order. For some test configurations, however, not all of these pages or data formats were available and hence do not appear in this report.

Page Order	Description
1	Test Hardware Photograph
2	Test Hardware Schematic
3	Table of Test Conditions
4	1/3 Octave Band PWL Spectrum
5	1/3 Octave Band SPL Spectrum at 110° from Nozzle Inlet Axis
6	1/3 Octave Band SPL Spectrum at 130° from Nozzle Inlet Axis
7	Overall SPL Beam Patterns
8	2128 Ft. Sideline PNL versus Ideal Jet Velocity
9	2128 Ft. Sideline PNL Suppression versus Ideal Jet velocity
10	2128 Ft. Sideline PNL Beam Patterns
11	2128 Ft. Sideline, 1/3 Octave Band SPL Spectrum at 110° from Nozzle Inlet Axis
12	2128 Ft. Sideline, 1/3 Octave Band SPL Spectrum at 130° from Nozzle Inlet Axis
13	Table of Jet Noise Source Location Test Conditions
14	1/3 Octave Band "Space Averaged" SPL Spectra versus Jet Length
15	

Page Order	Description
16	Jet Noise Source Intensity Distributions
17	Peak Jet Noise Source Locations
18	Total Pressure Profile @ $x/D_E = 1$
19	Total Pressure Profile @ $x/D_E = 5$
20	Total Temperature Profile @ $x/D_E = 1$
21	Total Temperature Profile @ $x/D_E = 5$
22	Static Pressure Profile @ $x/D_E = 1$
23	Static Pressure Profile @ $x/D_E = 5$



4.16 IN. DIA. REFERENCE NOZZLE

TEST CONDITIONS

NOZZLE: 4.16 IN. DIA., ROUND CONVERGENT

FACILITY: HNTF

DATE: 6-11-73

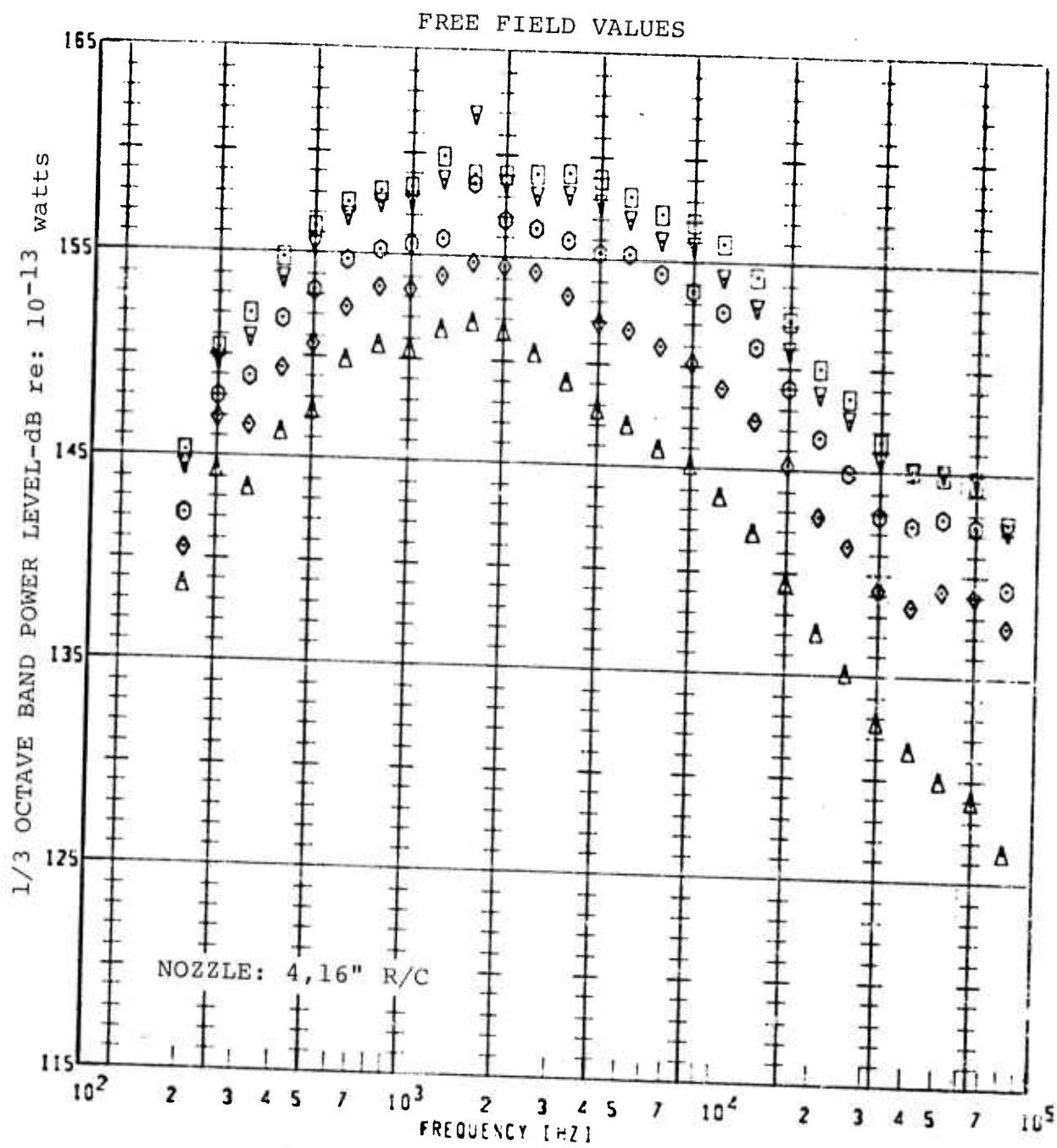
$T_{AMB} = 65^{\circ}\text{F}$

R.H. = 55.5%

SCALE MODEL $A_8 = 13.6 \text{ in.}^2$

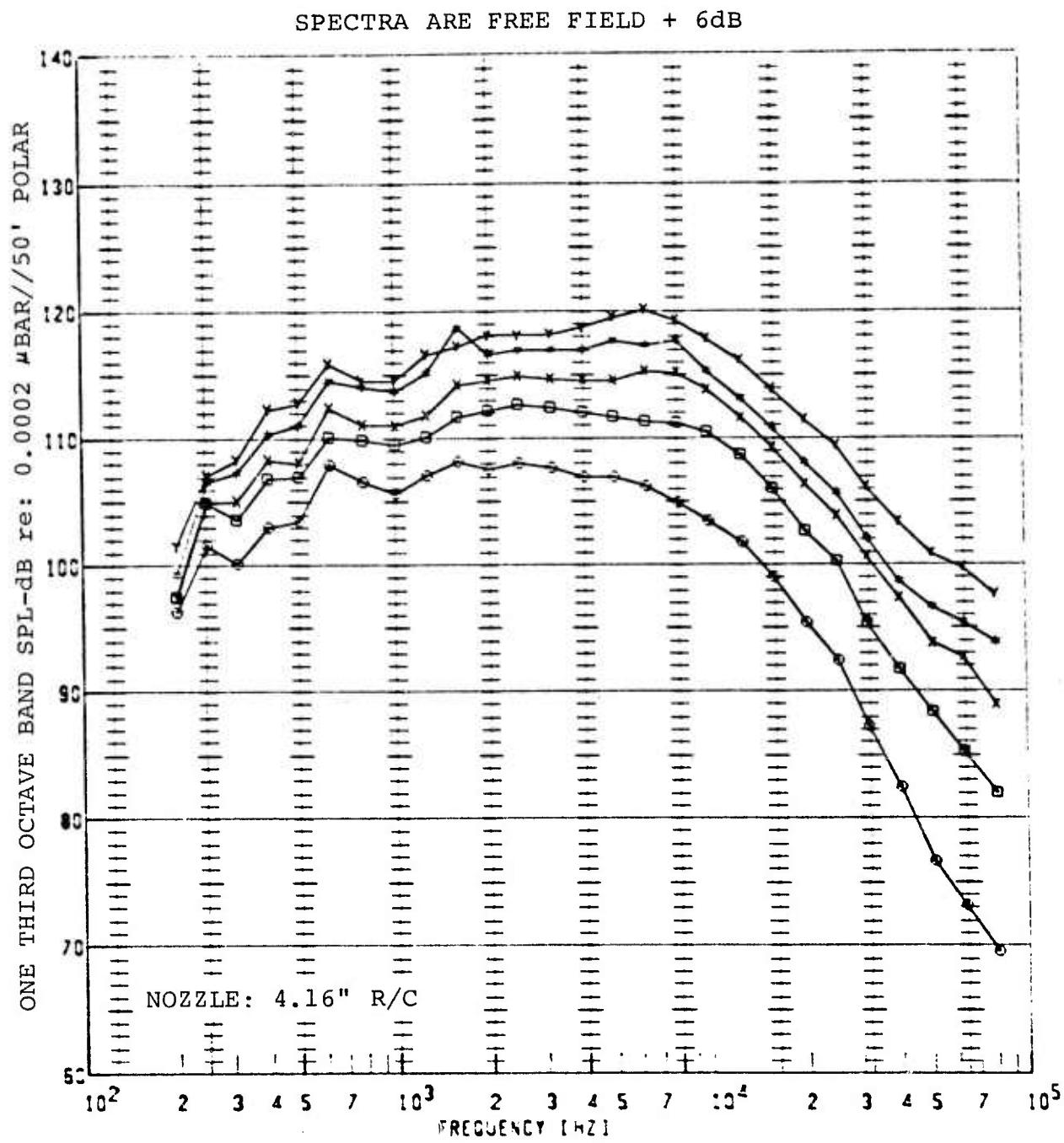
<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
007	2.0	1150°F	1875 fps		
"	2.5		2126		
"	3.0		2303		
"	3.5		2437		
"	4.0		2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



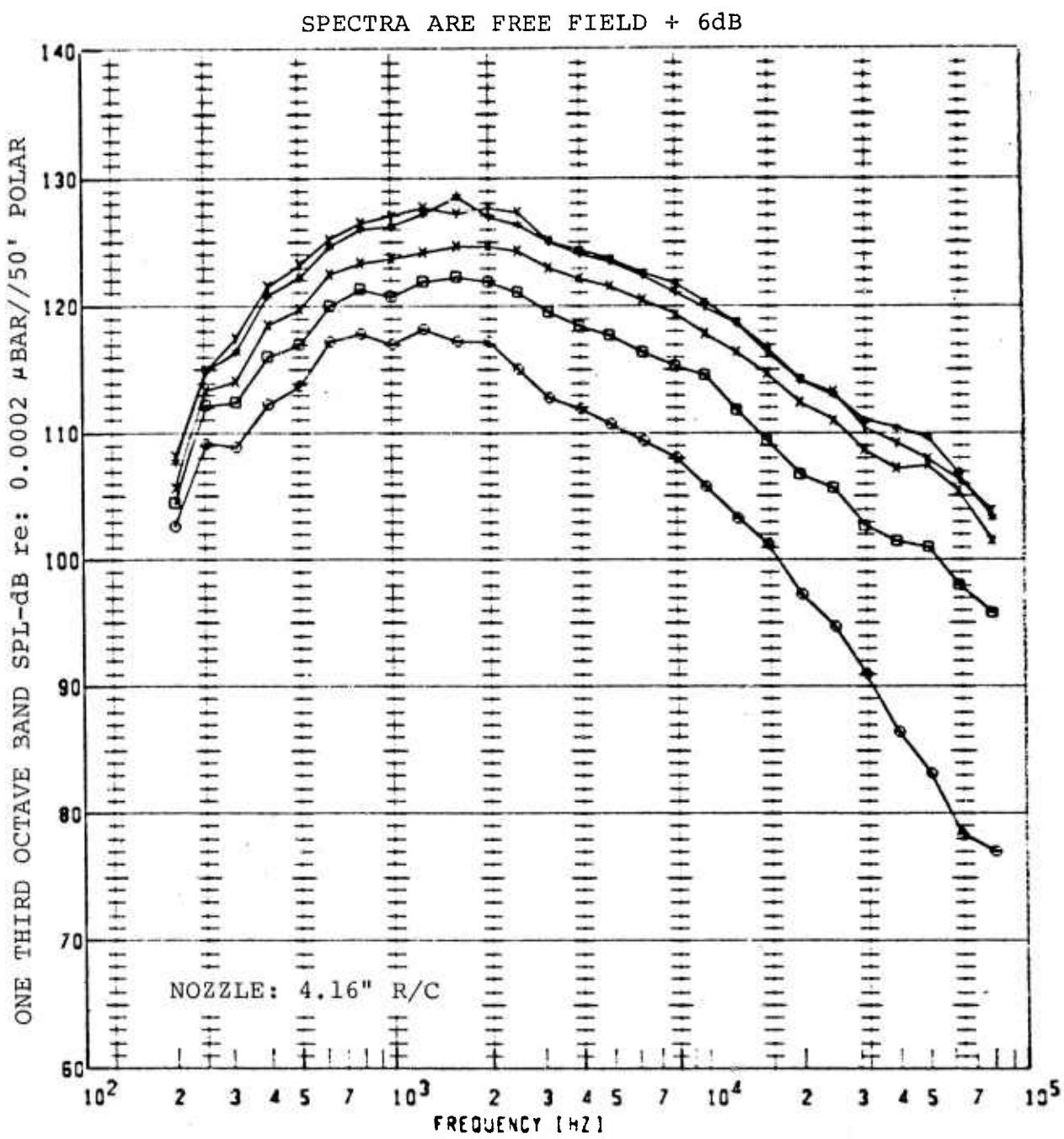
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
▲	007	2.00	1150°F
◊	007	2.50	1150
○	007	3.00	1150
▽	007	3.50	1150
□	007	4.00	1150

JET NOISE POWER SPECTRA



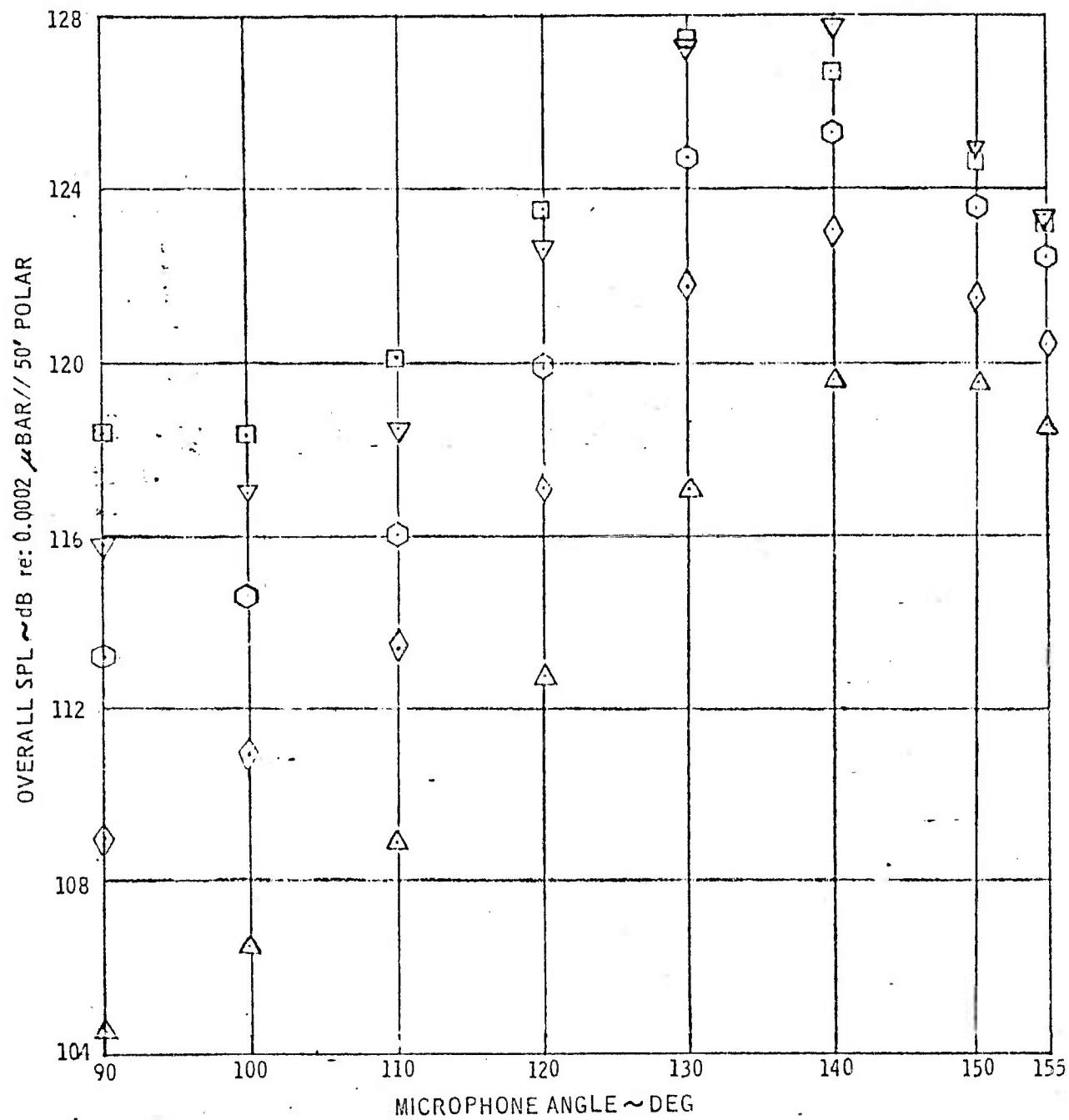
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [dB]
@	007G	1150°F	2.000	110°	SOPP	118.7
@	007G	1:50	2.500		SOPP	123.1
x	007G	1150	3.000		SOPP	125.7
*	007G	1150	3.500		SOPP	128.2
*	007G	1:50	4.000	↓	SOPP	129.7

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS

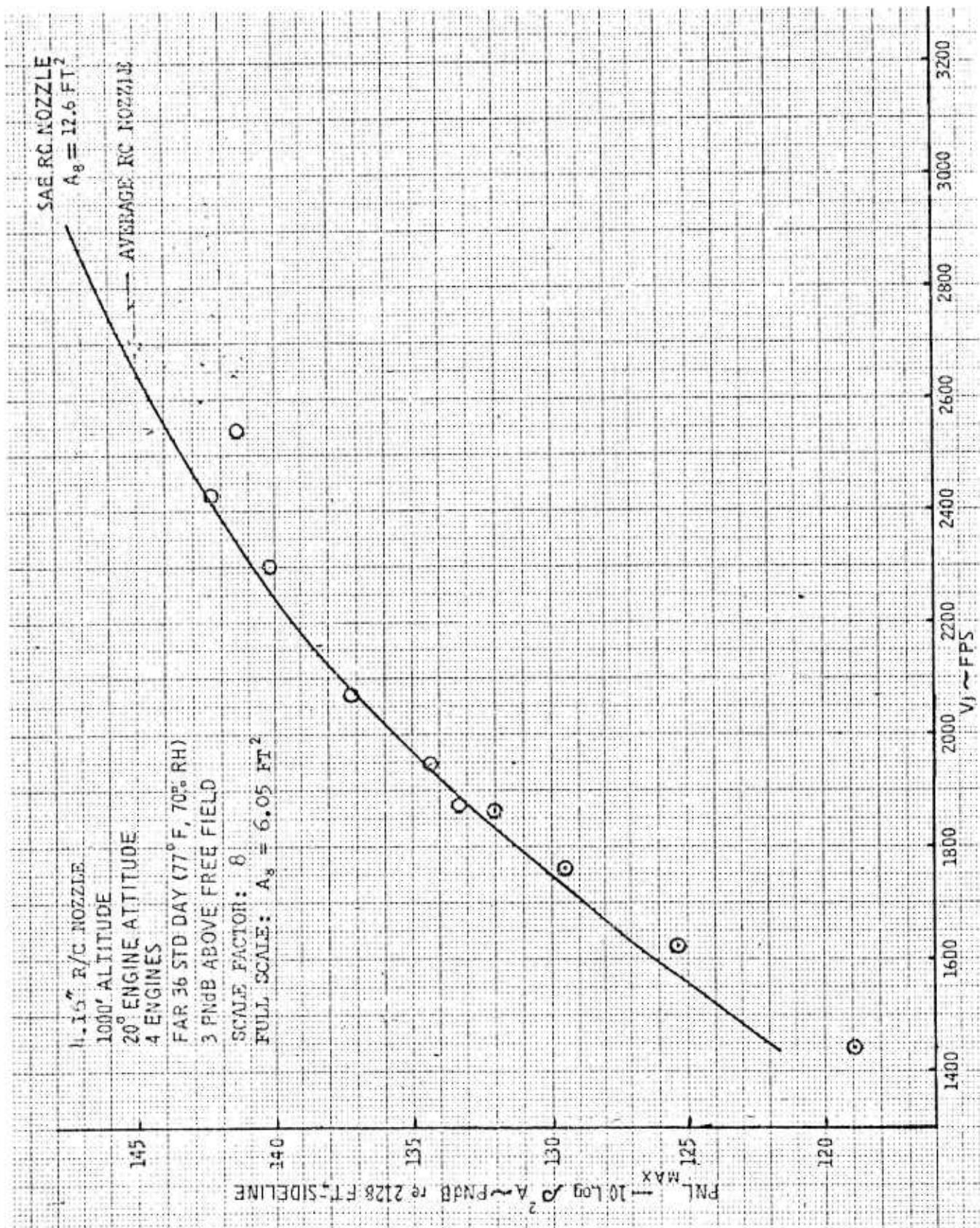
FREE FIELD VALUES



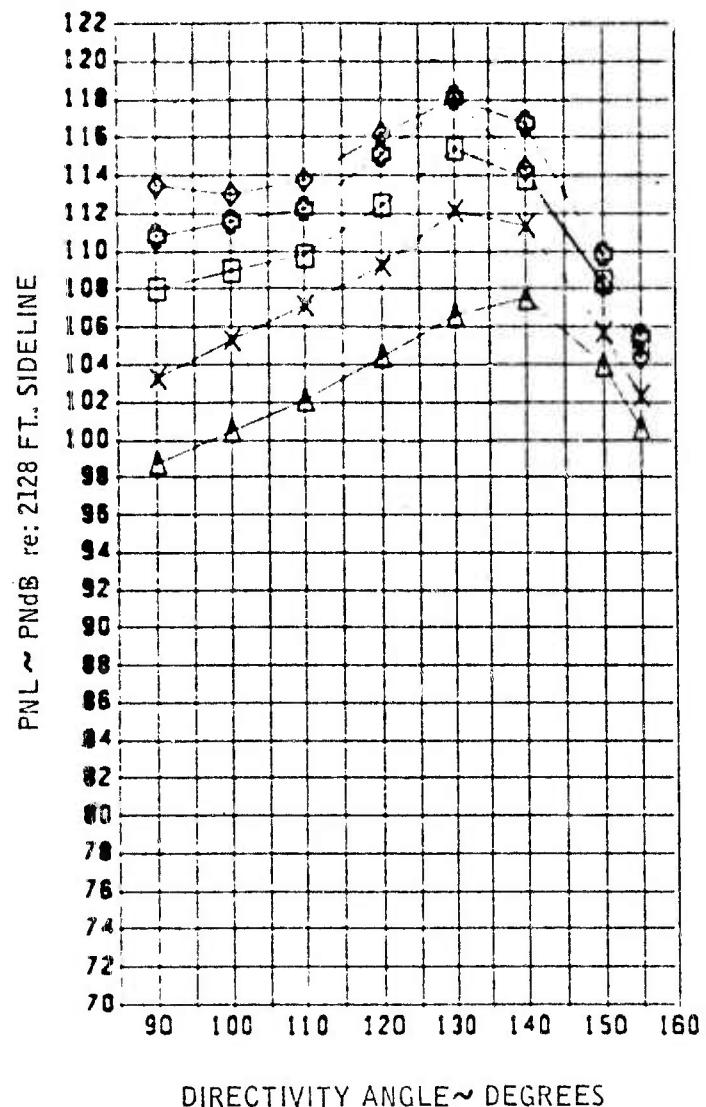
NOZZLE: 4.16" R/C

PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	SET TEMP
Δ	007	2.00	1150°F
◊	007	2.50	1150
○	007	3.00	1150
▽	007	3.50	1150
□	007	4.00	1150

OASPL BEAM PATTERNS



NOZZLE: 4.1" R/C

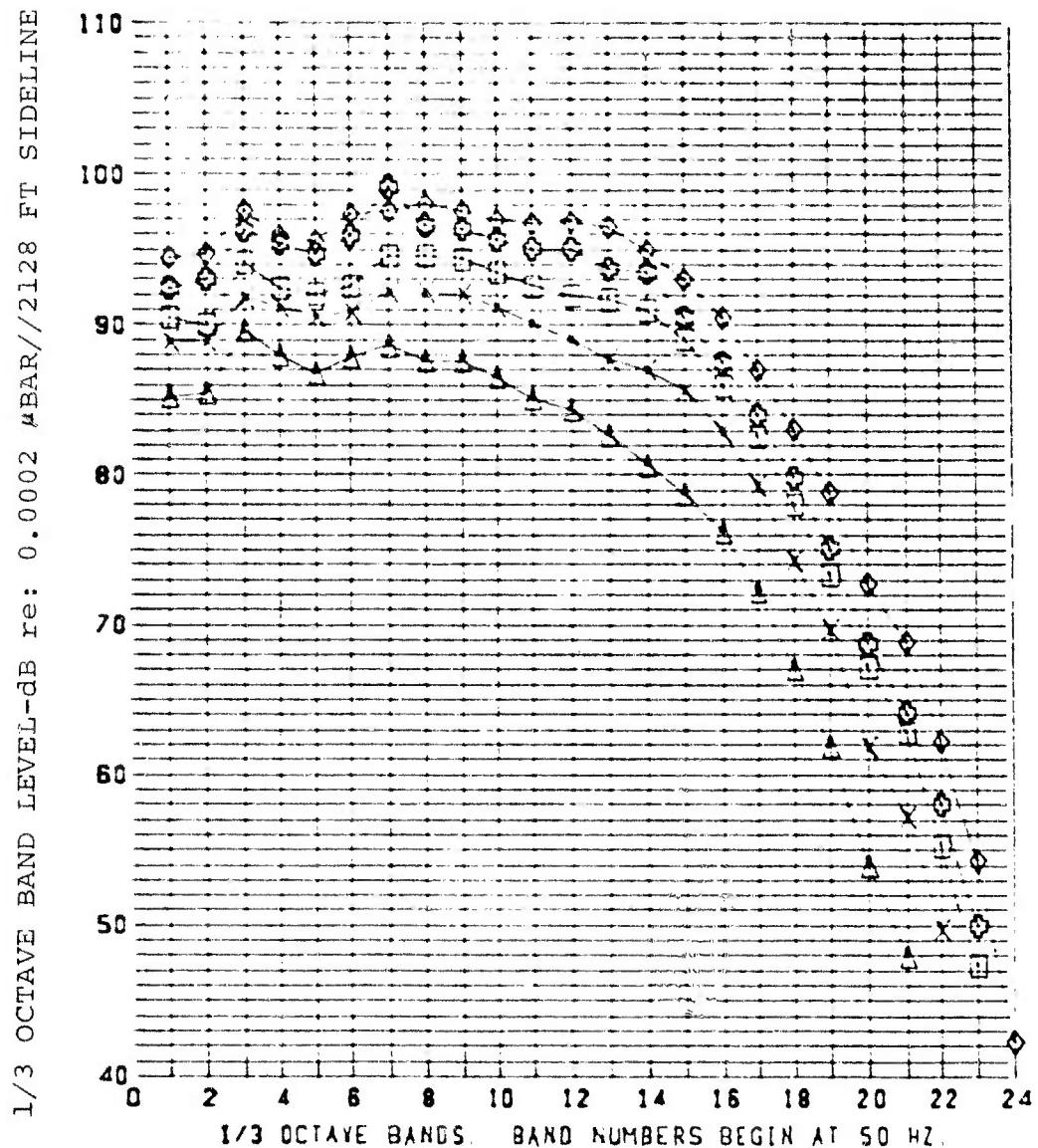


TT = 1150°F A8 = 6.05 FT² RUN:007
PR = △ 2.0, × 2.5, □ 3.0, + 3.5, ◇ 4.0

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN:007

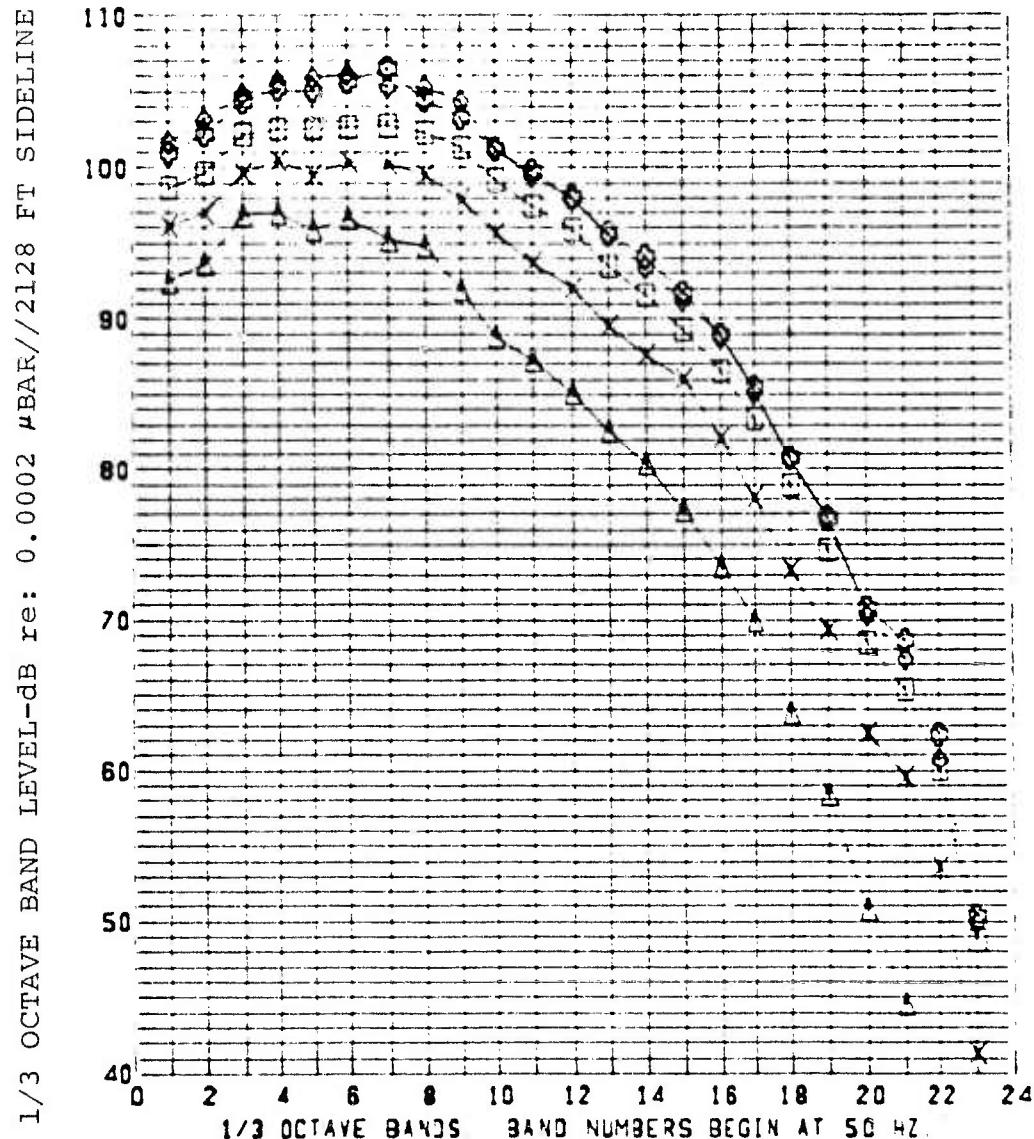
PR = △ 2.0, X 2.5, □ 3.0, + 3.5, ◇ 4.0

NOZZLE: 4.16 " R/C

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110° re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 007

PR = Δ 2.0, X 2.5, □ 3.0, + 3.5, ◇ 4.0

NOZZLE: 4.16 R/C

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°

re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 4.16" R/C

FACILITY: WALL ISOLATION FACILITY

DATE: August 11, 1972

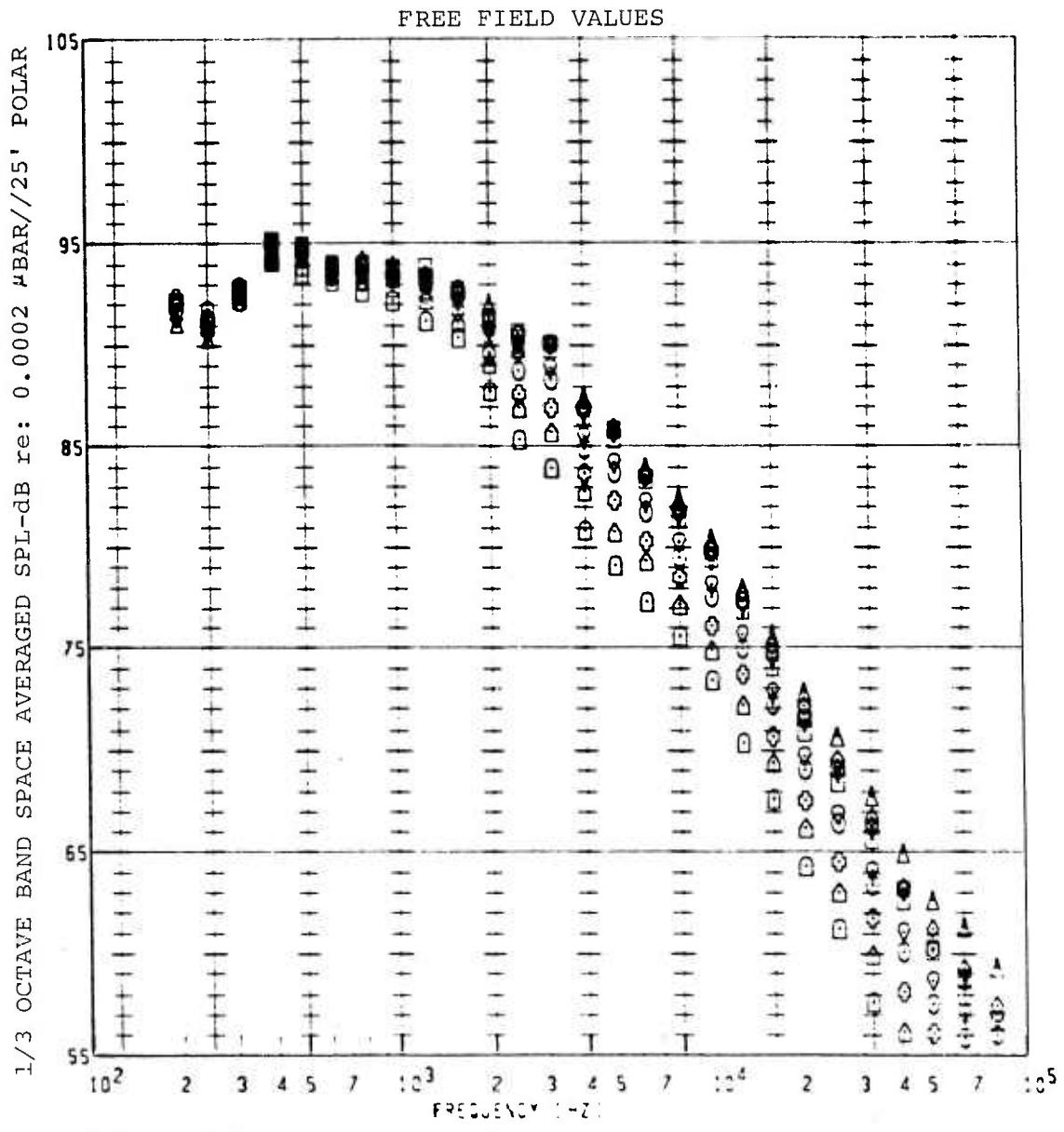
P_{AMB} = 30.3 in Hg **T_{AMB}** = 71°F **R.H.** = 49%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

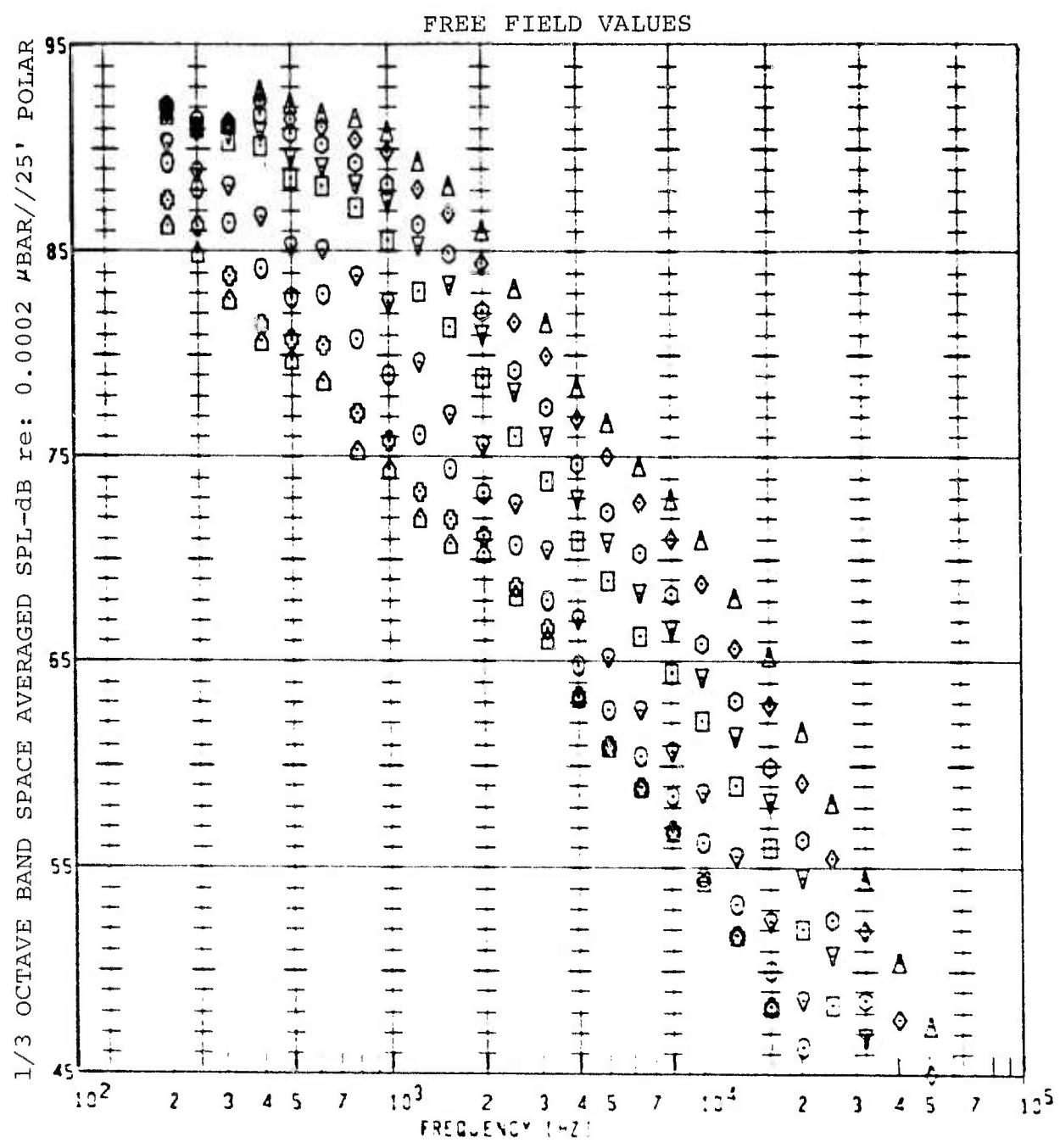
SCALE MODEL A₈ = 13.6 in.²

RUN NO.	AXIAL LOCATION	IRIS DIA.	REMARKS	REF.
1	0.0 x/D	6.0 in.		
2	1.0	6.0		
3	2.0	7.4		
4	3.0	8.4		
5	4.0	9.4		
6	5.0	10.4		
7	6.0	11.4		
8	7.0	12.4		
9	8.0	13.6		
10	9.0	14.4		
11	10.0	15.6		
12	11.0	16.0		
13	12.0	16.4		
14	13.0	17.0		
15	14.0	17.4		
16	16.0	22.4		
17	18.0	24.4		
18	20.0	26.4		
19	21.0	28.4		

MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC



PLOT SYMBOL	RUN NUMBER	TEMP	P.R.	AXIAL LOCATION, X/D
▲	1	1150°F	3.0	0.0
△	2		1.0	
○	3		2.0	
◊	4		3.0	
◆	5		4.0	
◆	6		5.0	
◆	7		6.0	
◆	8		7.0	
◆	9		8.0	
◆	10		9.0	



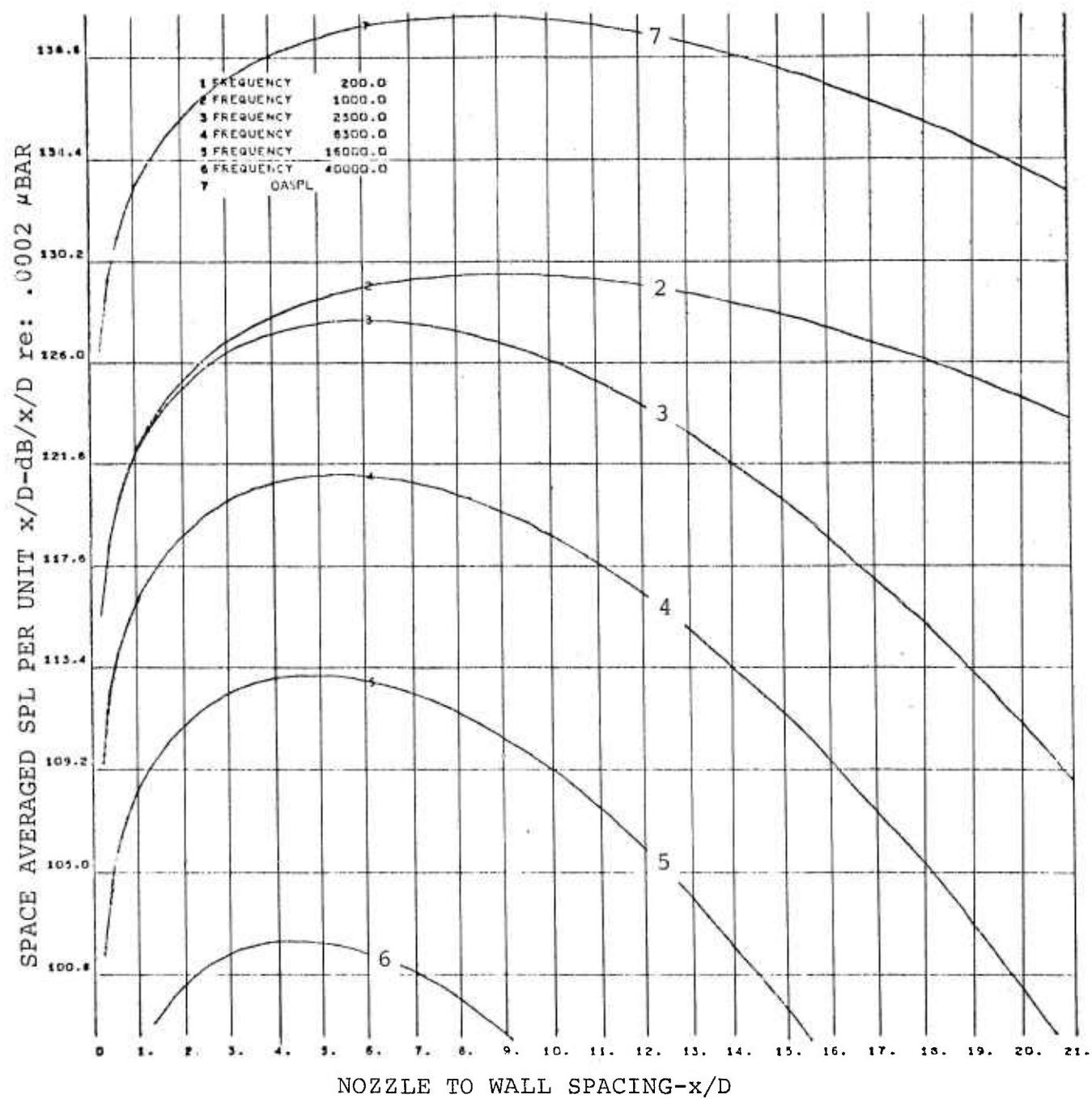
SET
SPL 30°
RUN NUMBER
11
12
13
14
15
16
17
18
19

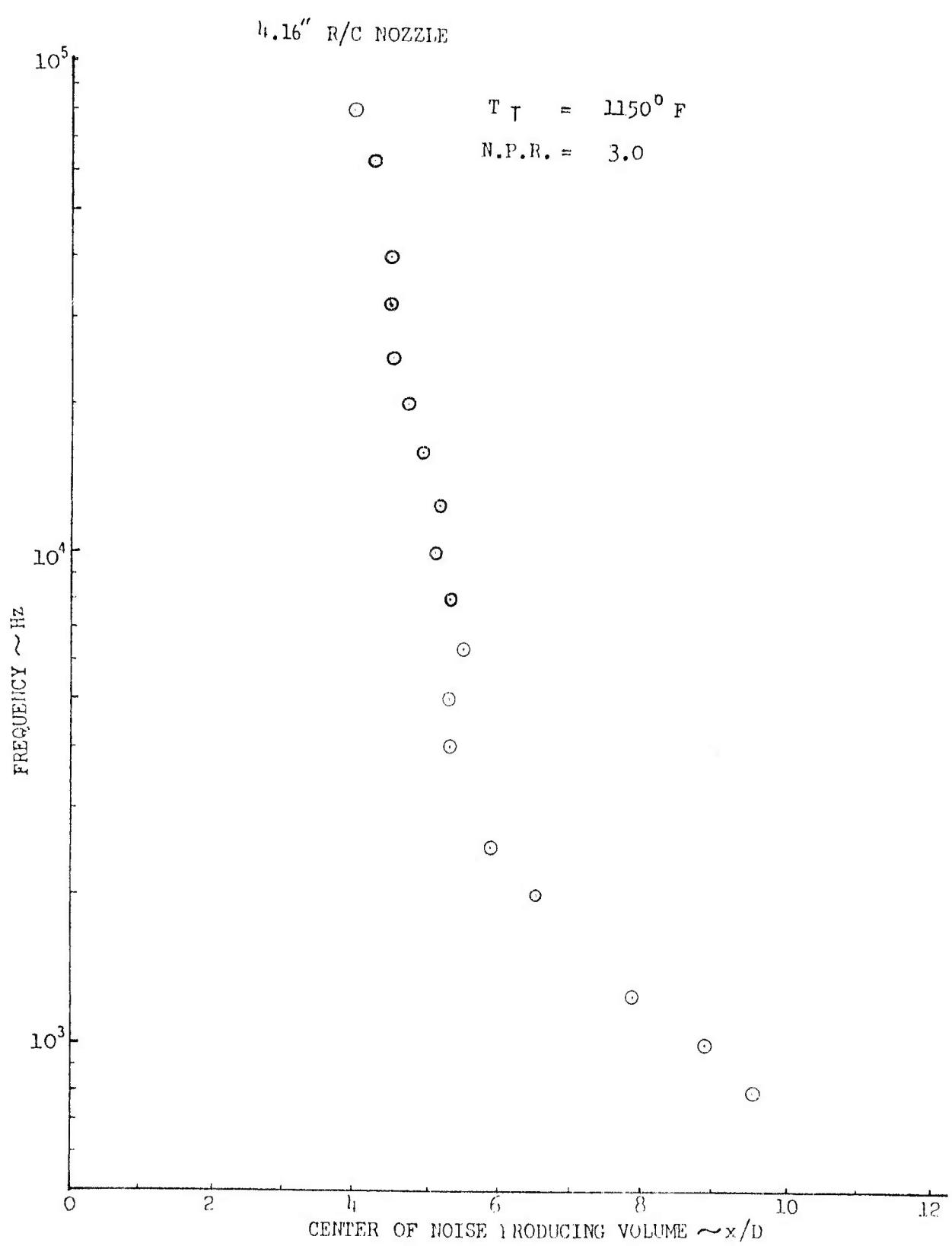
SET
TEMP

1150 °F
↓

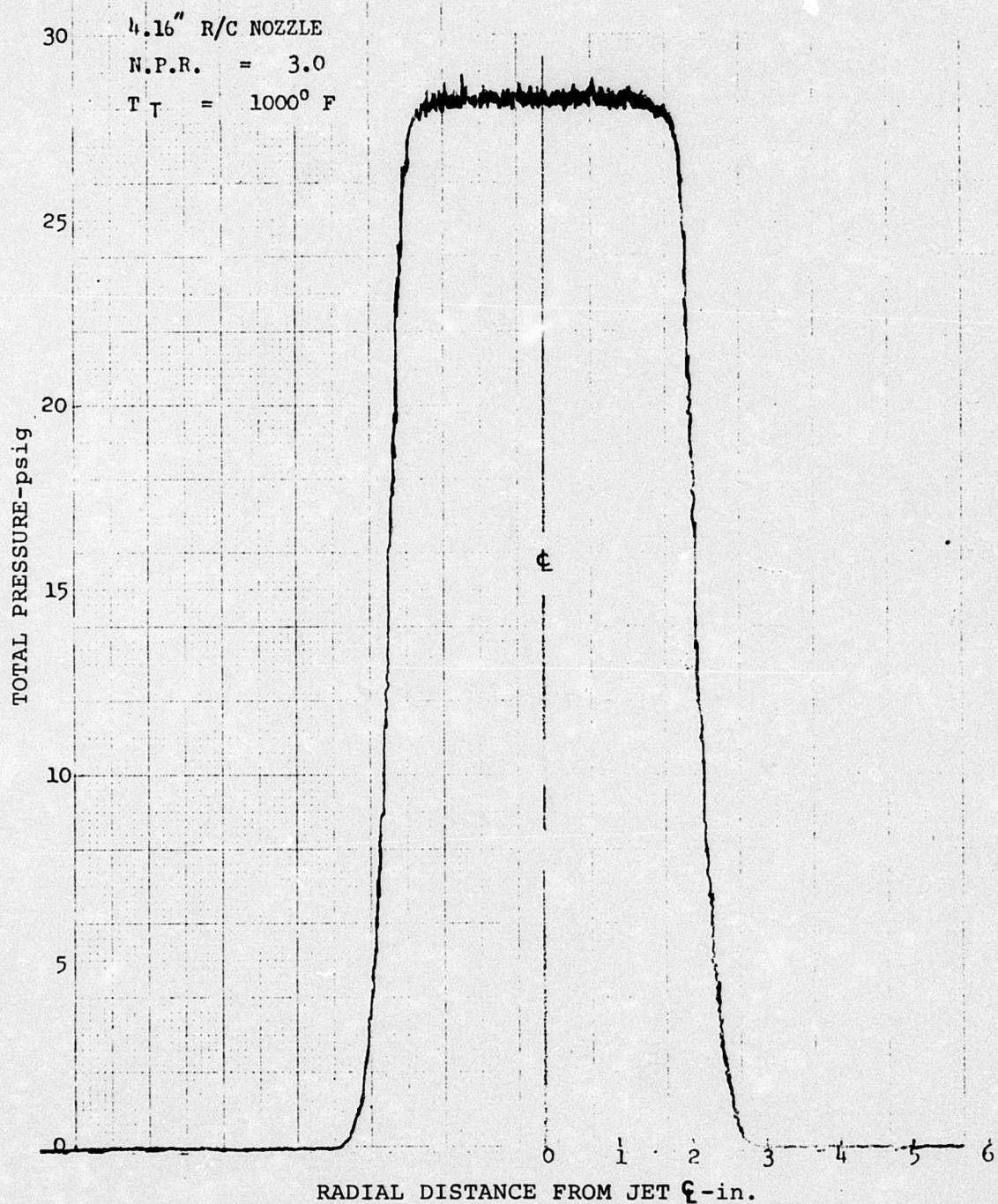
PRESSURE AXIAL
RATIO LOCATION, x/D

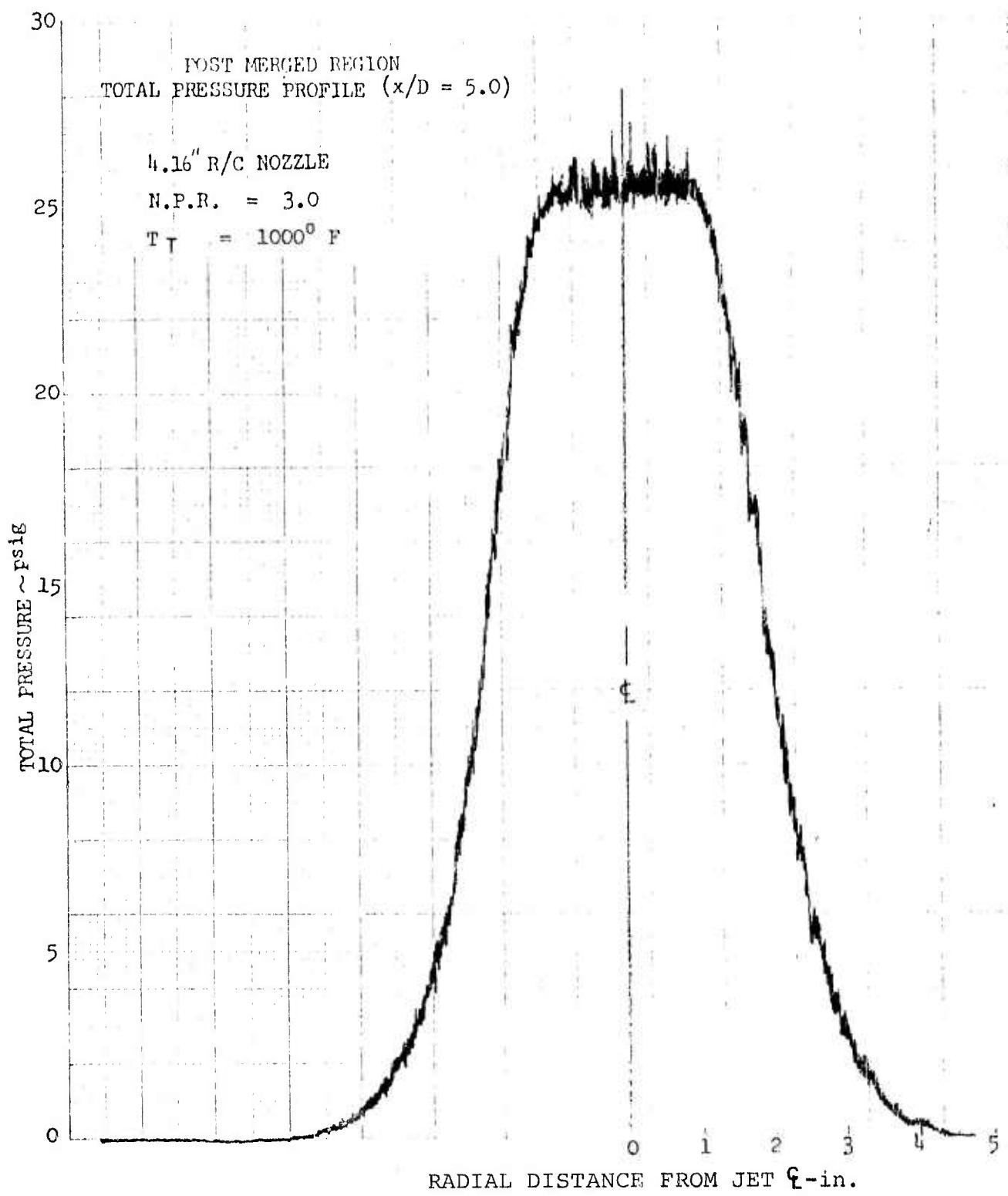
3.0 10.0
2.8 11.0
2.6 12.0
2.4 13.0
2.2 14.0
2.0 15.0
1.8 16.0
1.6 17.0
1.4 18.0
1.2 19.0

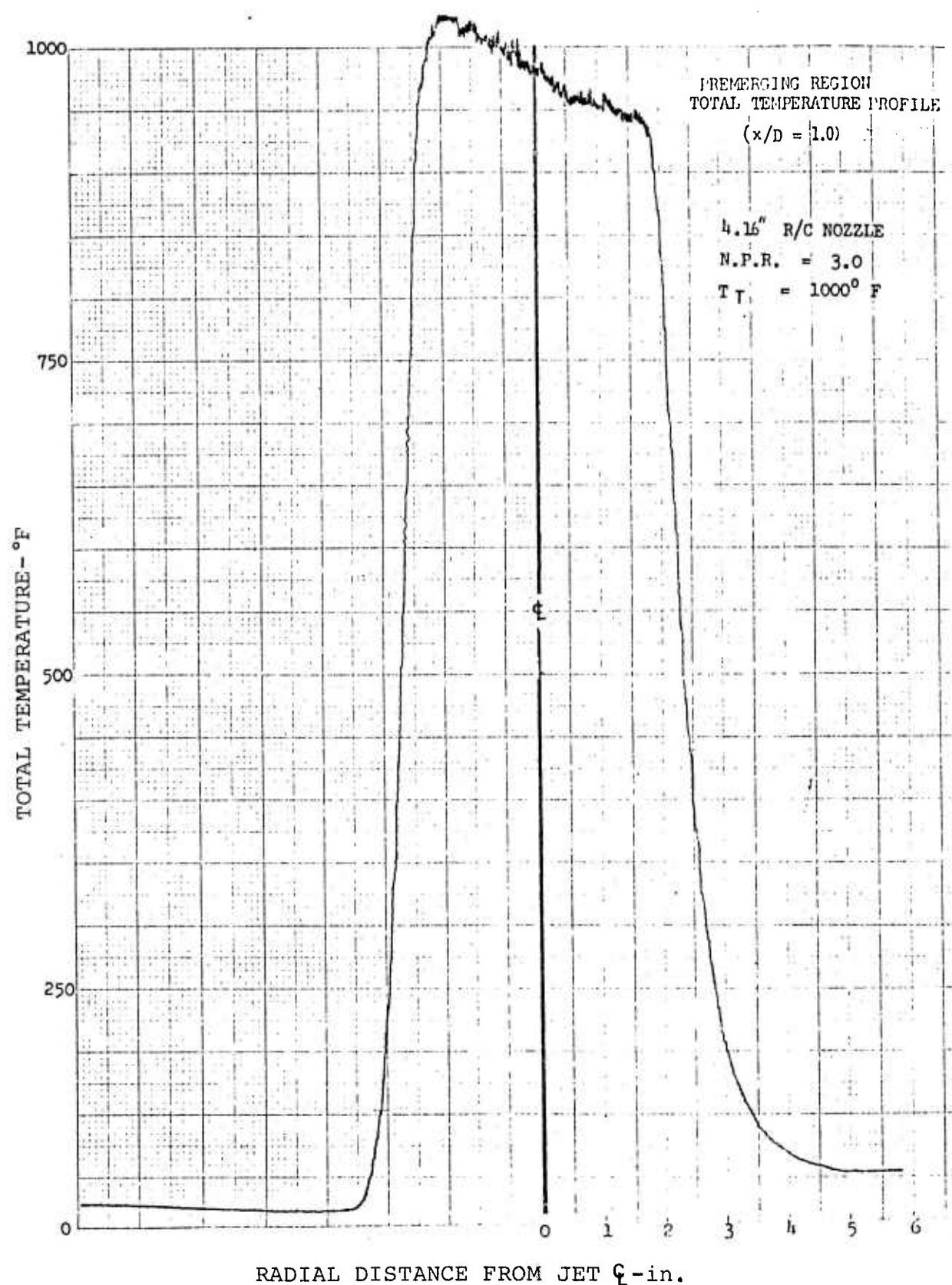


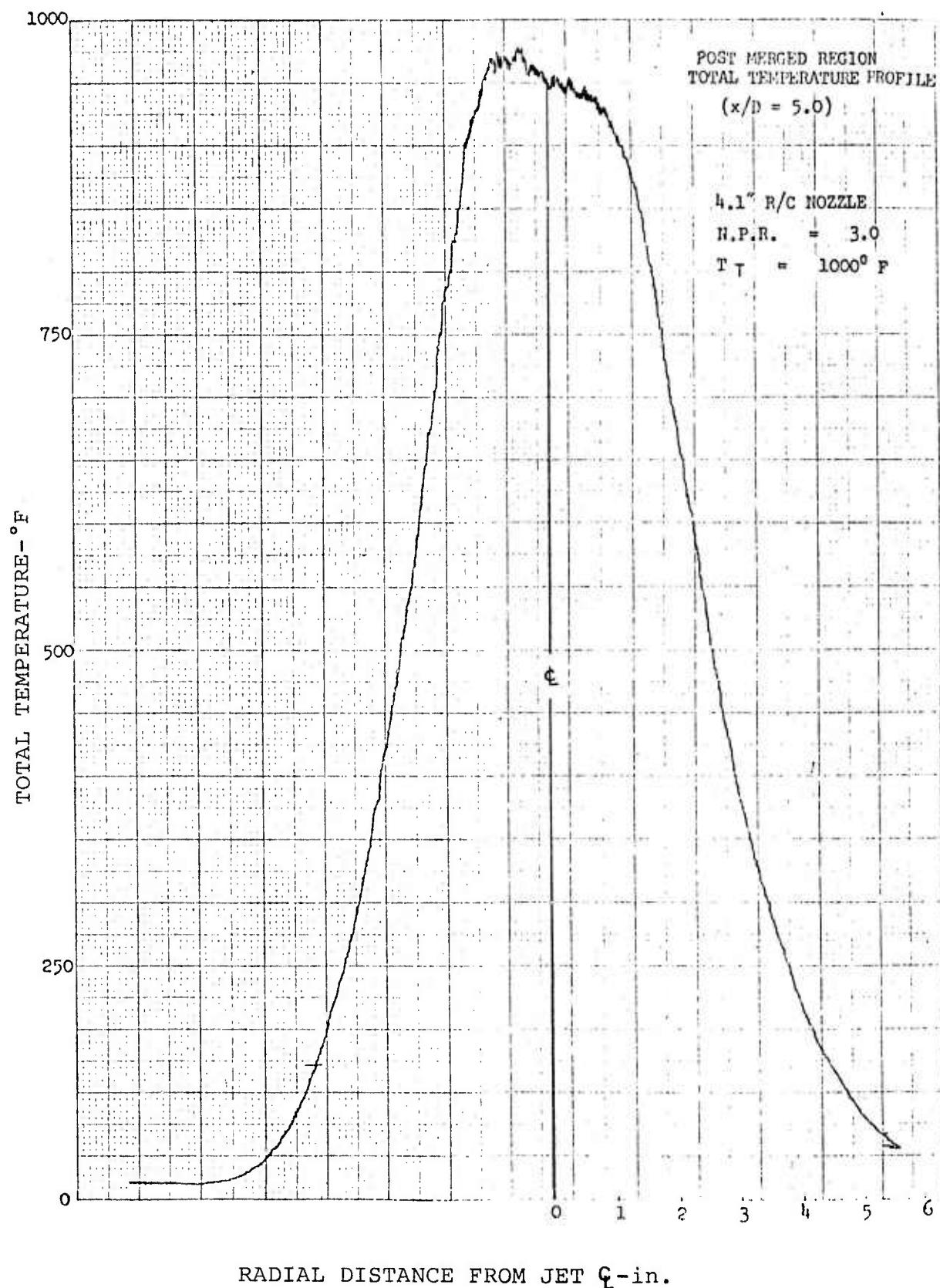


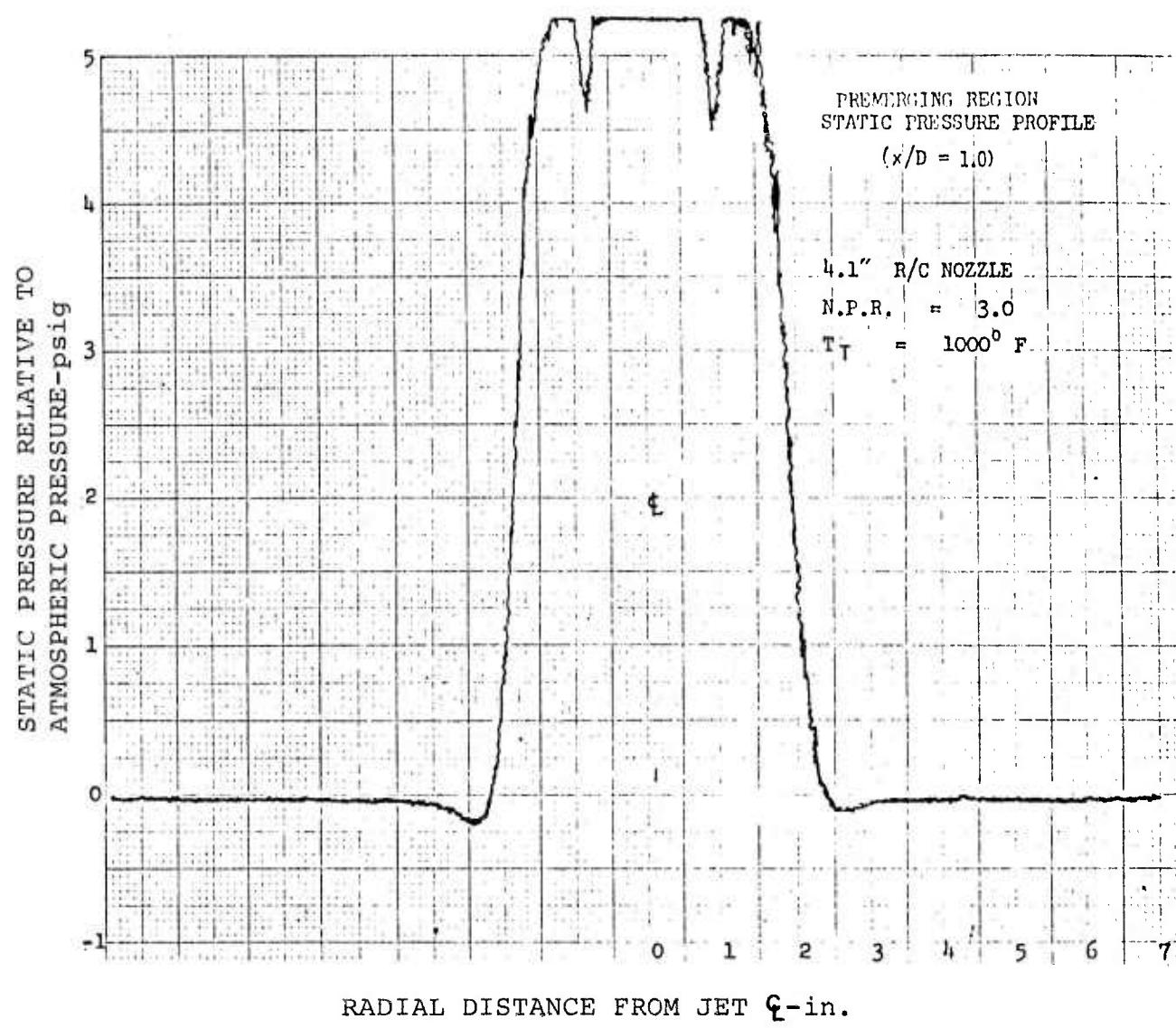
PREMERGING REGION
TOTAL PRESSURE PROFILE ($x/D = 1.0$)

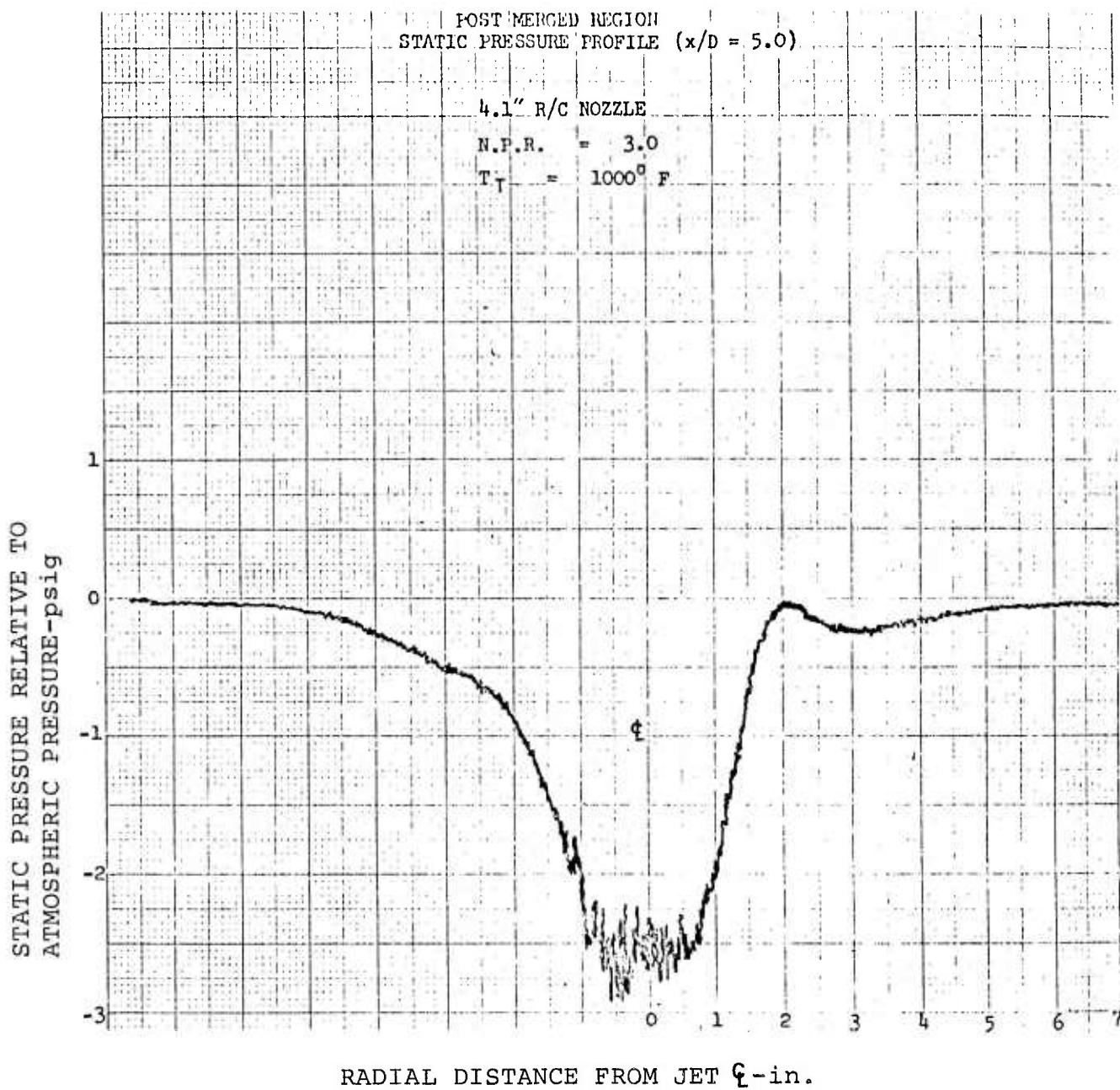












TEST CONDITIONS

NOZZLE: 6 IN. DIA. ROUND CONVERGENT

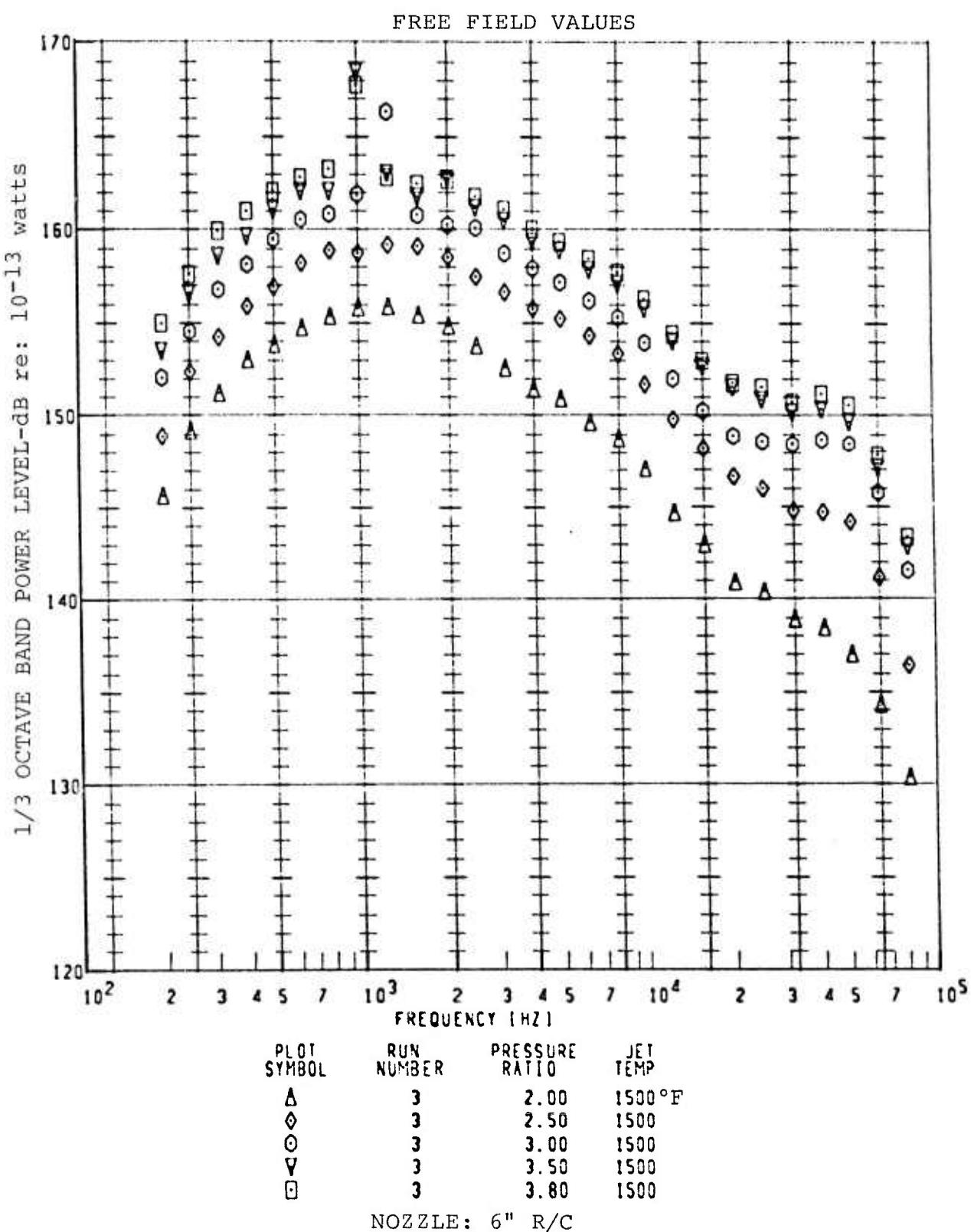
FACILITY: HNTF

DATE: 11-21-73 **T_{AMB}** = **R.H.** =

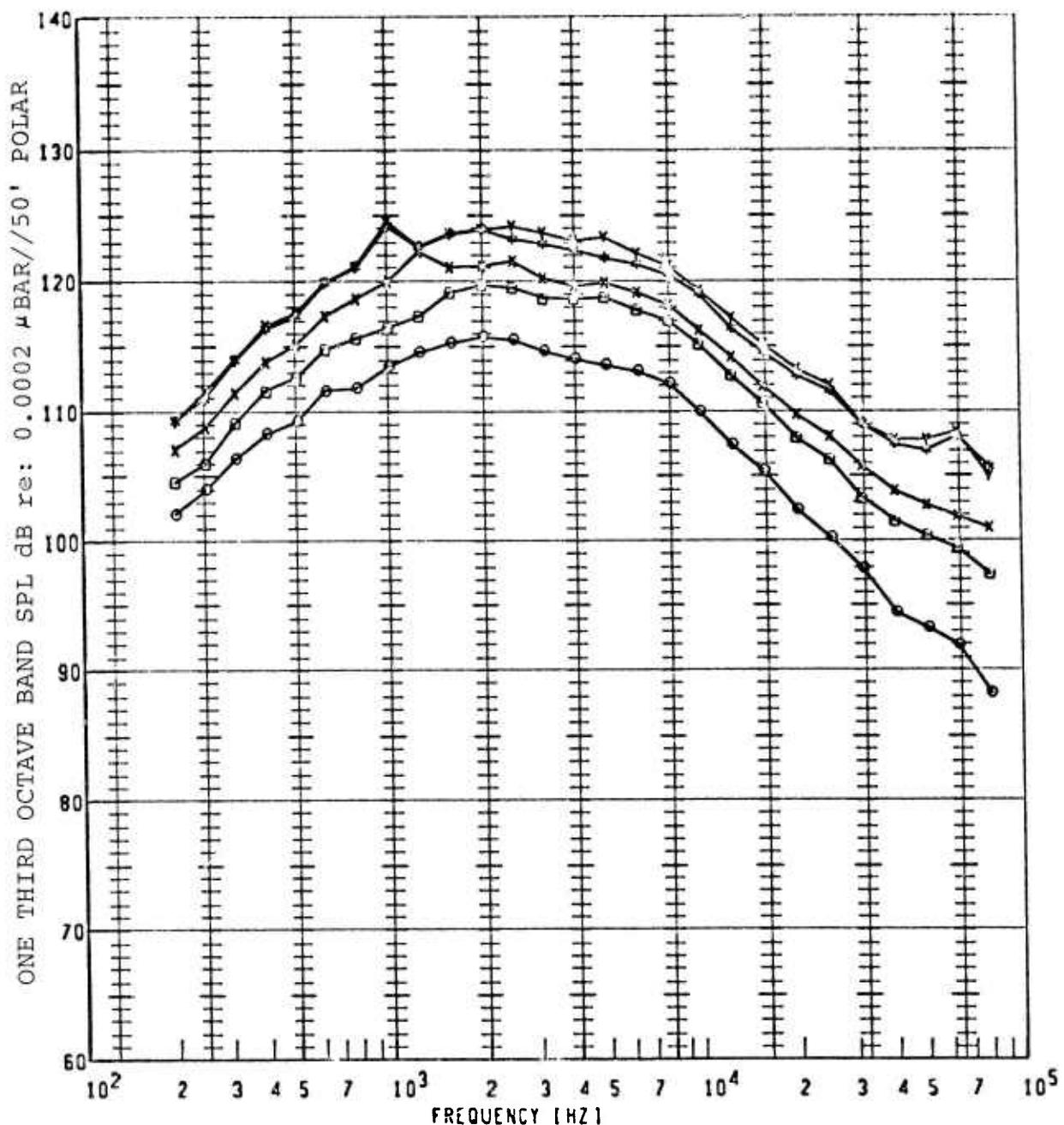
SCALE MODEL A₈ =

RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
03	2.0	1500°F	2072 fps	11-21-73	
"	2.5	"	2351	"	
"	3.0	"	2548	"	
"	3.5	"	2697	"	
"	3.8	"	2771	"	

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

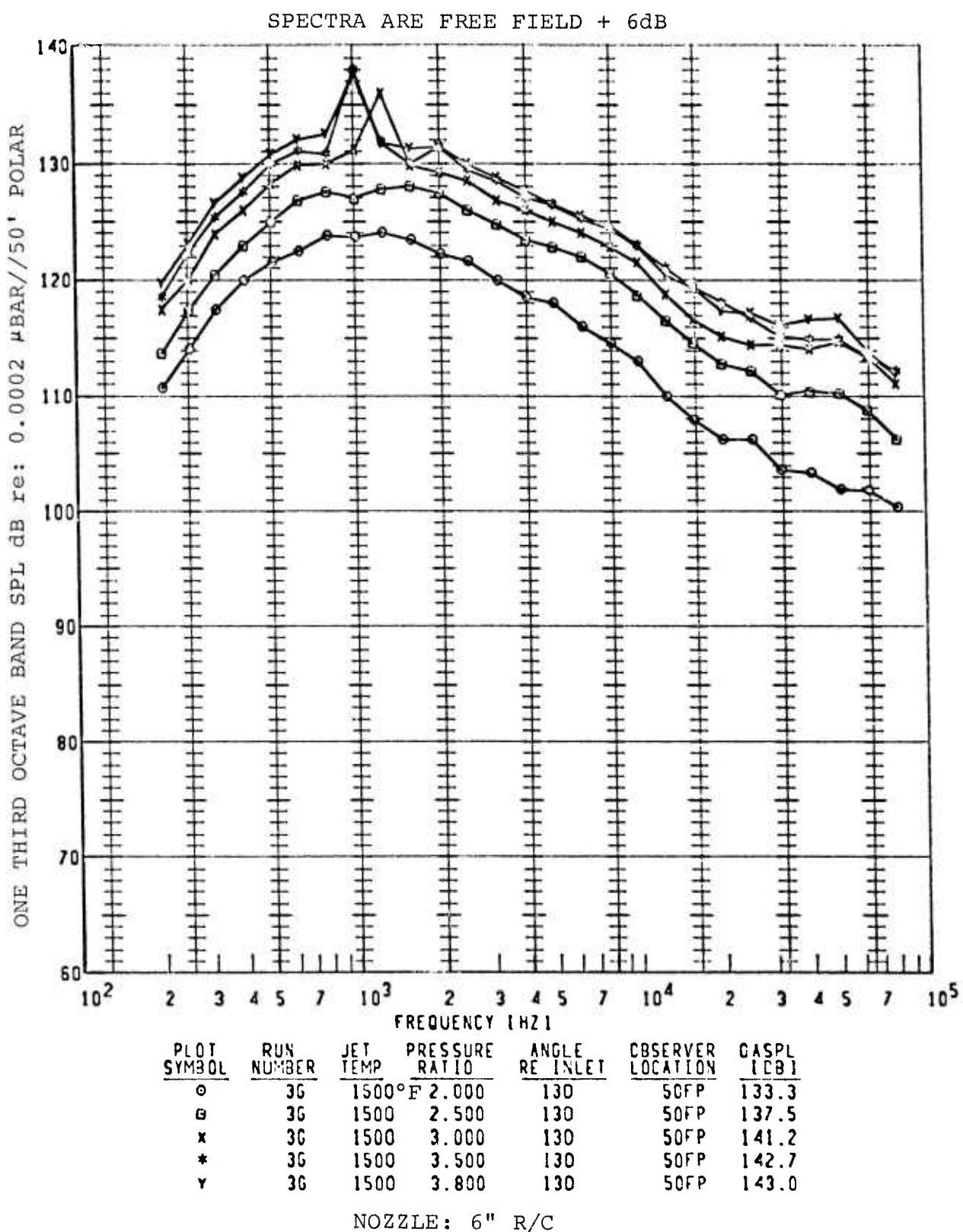


SPECTRA ARE FREE FIELD + 6dB

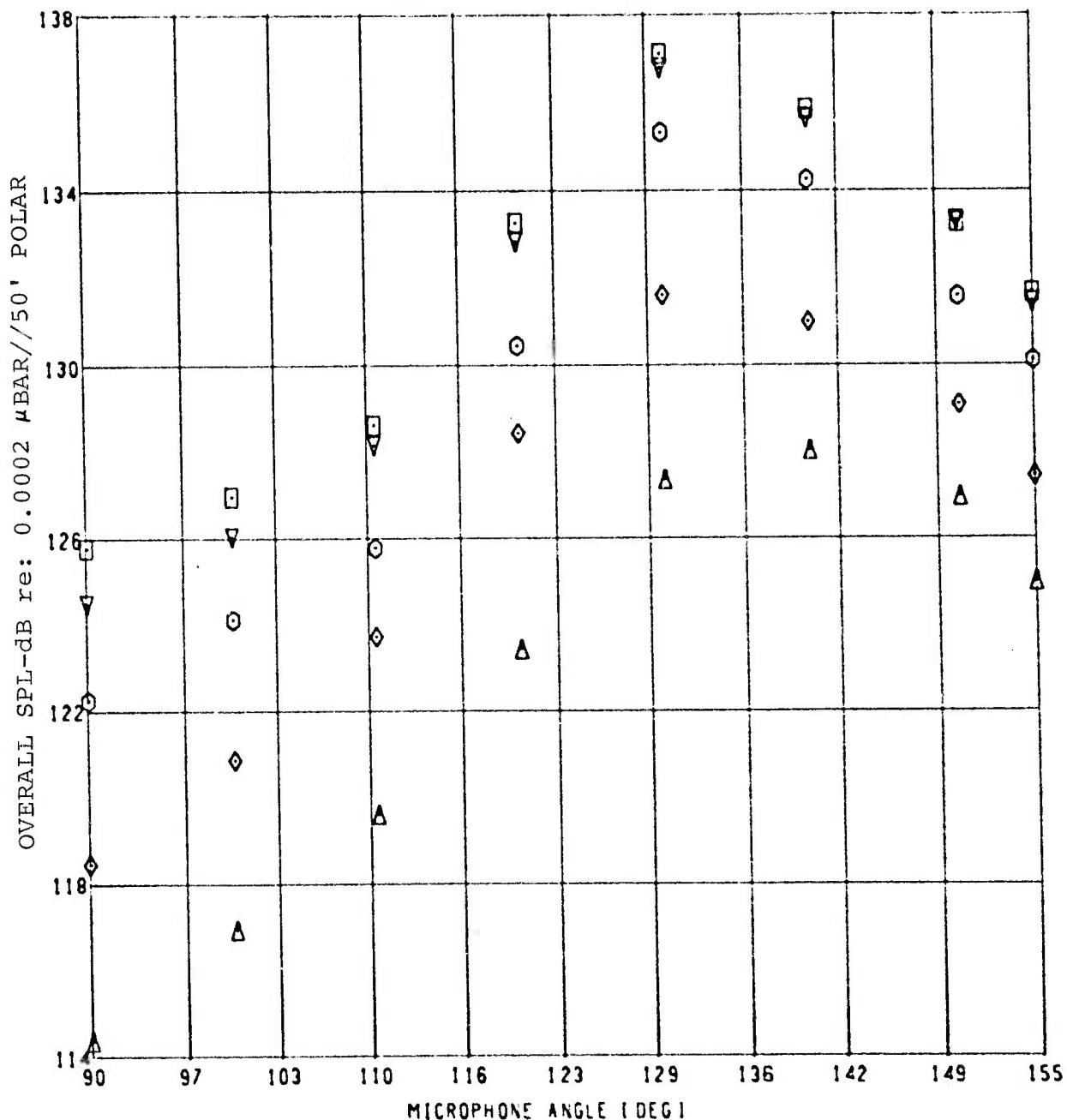


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL 10DBI
o	36	1500°F	2.000	110	50FP	125.4
o	36	1500	2.500	110	50FP	129.5
x	36	1500	3.000	110	50FP	131.6
*	36	1500	3.500	110	50FP	133.9
y	36	1500	3.800	110	50FP	134.4

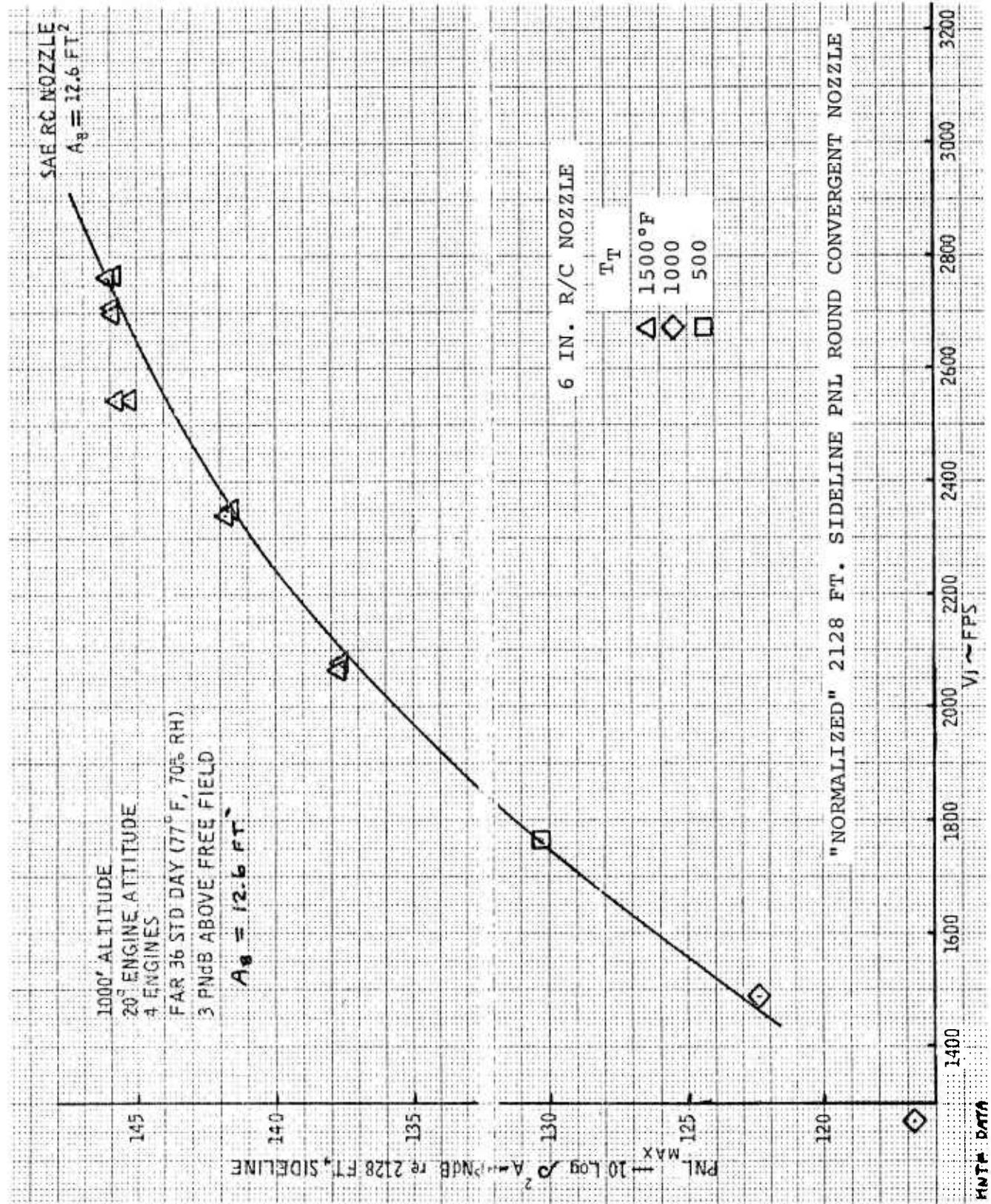
NOZZLE: 6" R/C

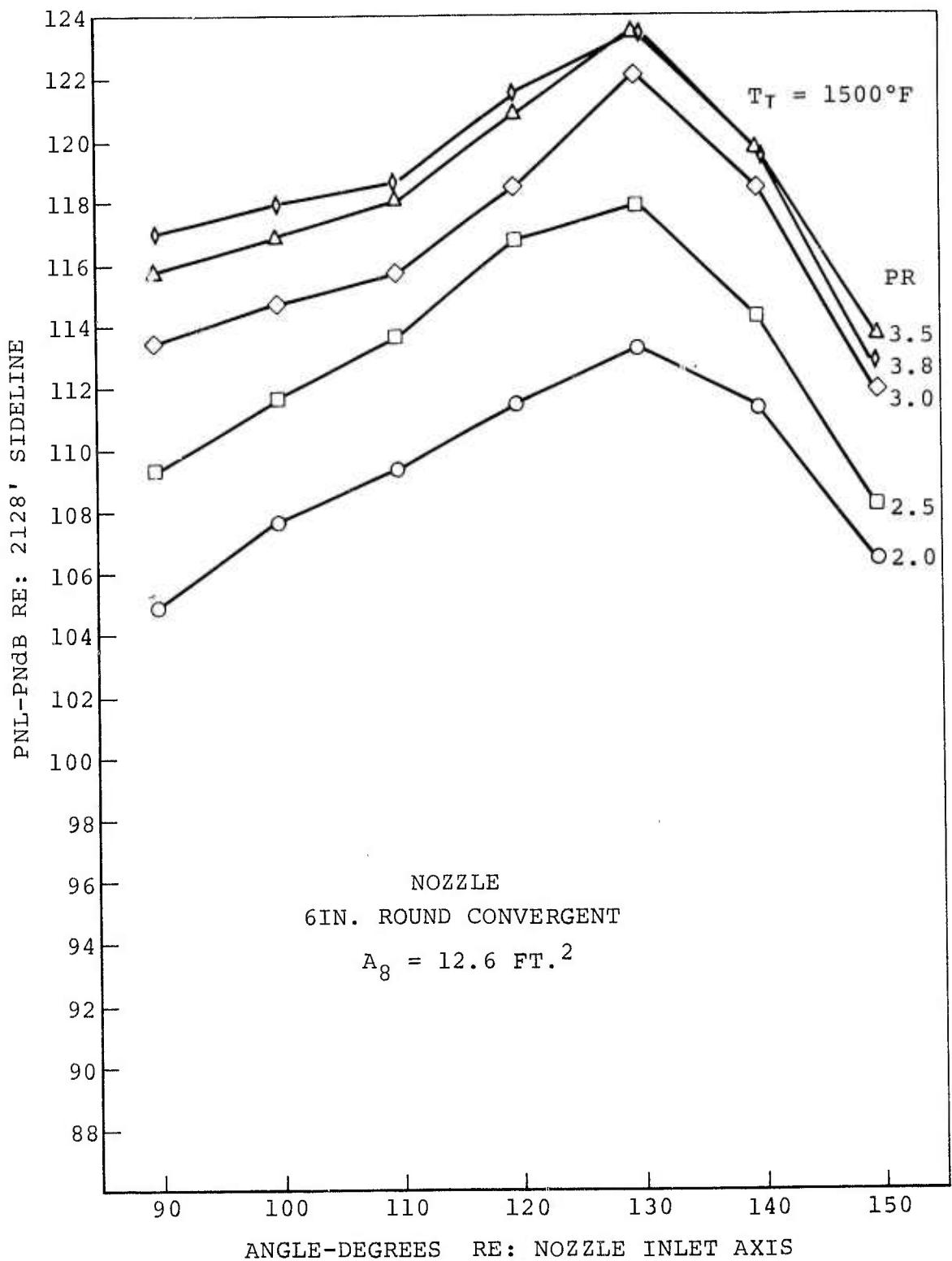


FREE FIELD VALUES

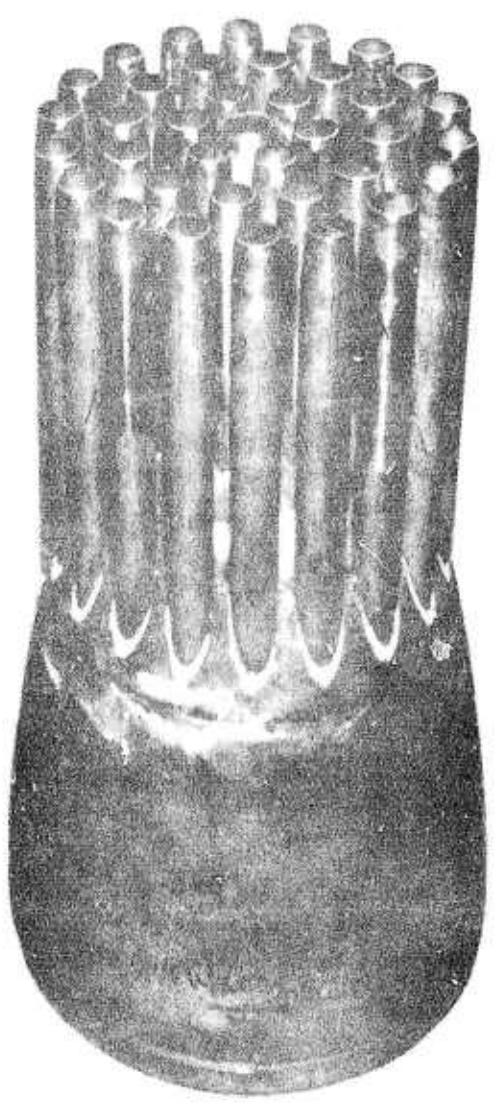


NOZZLE: 6" R/C





ROUND CONVERGENT NOZZLE PERCEIVED NOISE LEVEL BEAM PATTERN



37TUBE, 3.3 AREA RATIO REFERENCE NOZZLE

NO
SCHEMATIC
AVAILABLE

NOZZLE EXIT PATTERN SIMILAR TO THAT SHOWN ON PAGE 109

37T-3.3AR-CPA-RT/RC NOZZLE

TEST CONDITIONS

NOZZLE: 37T-3.3AR-CPA-RT/RC

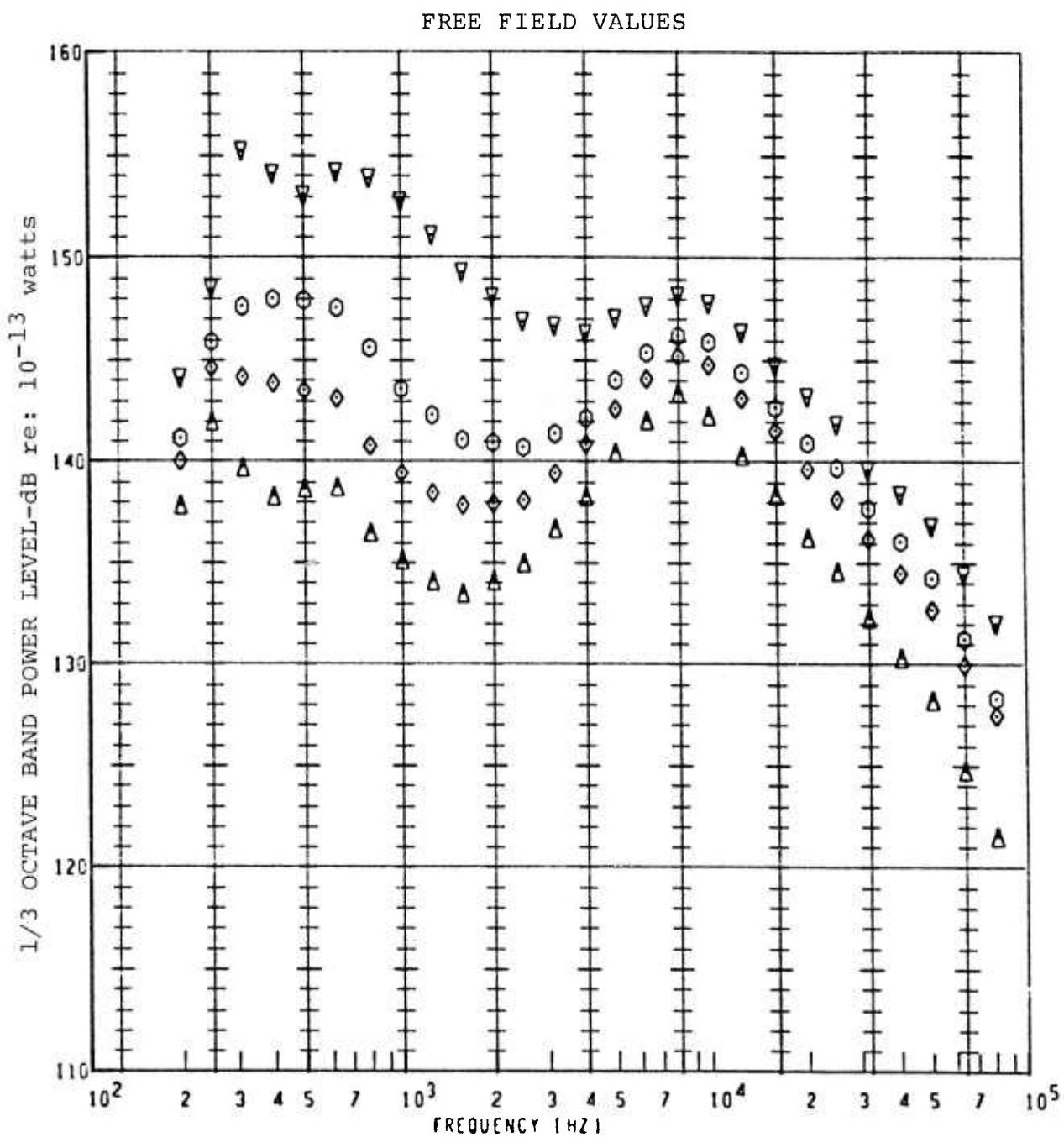
FACILITY: HNTF

DATE: T_{AMB} = **R.H.** =

SCALE MODEL A₈ = 13.6 in.²

RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
66	2.0	1150°F	1875 fps		
"	2.5	"	2126		
"	3.0	"	2303		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

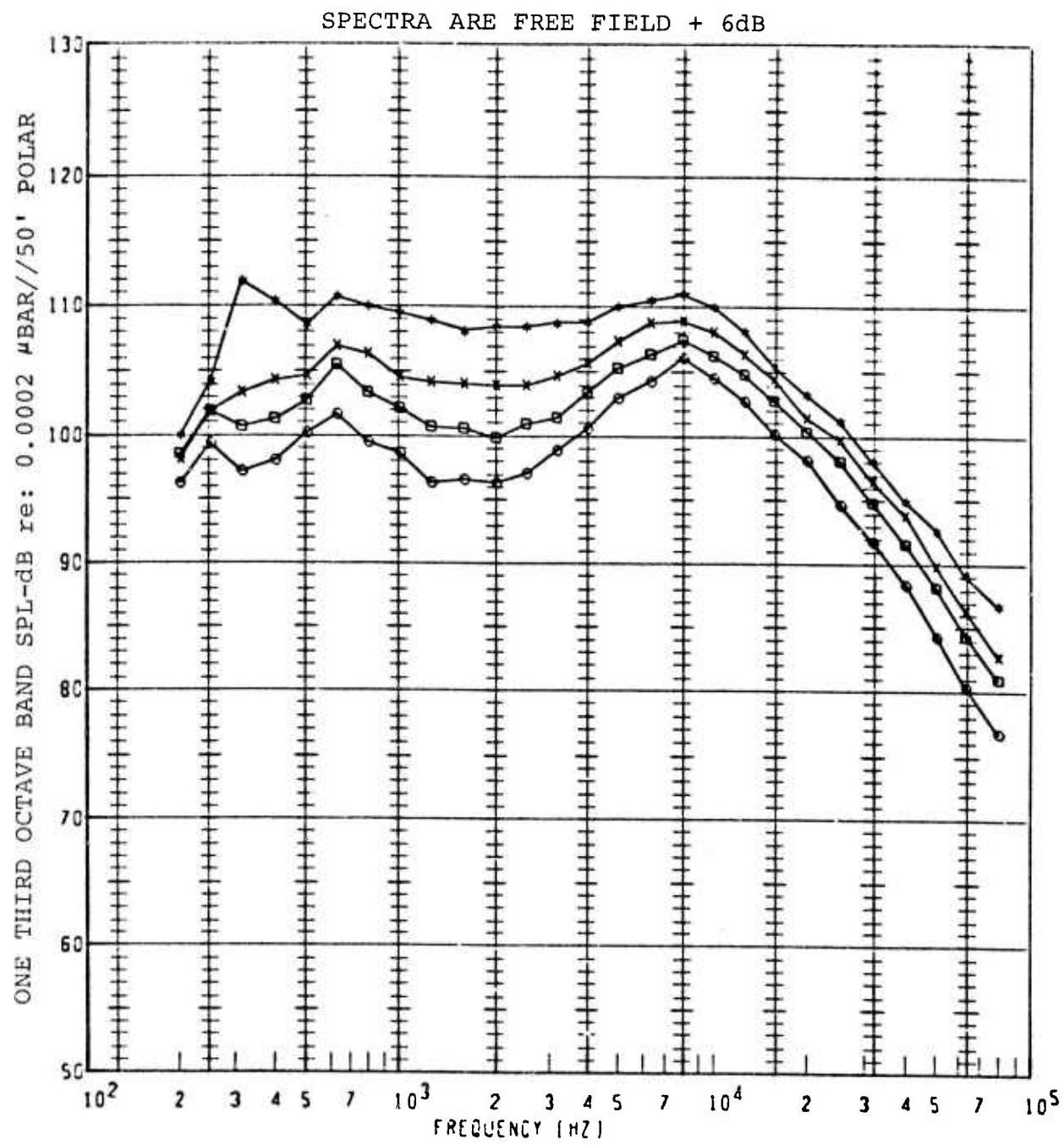


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	66	2.00	1150 °F
◊	66	2.50	1150
○	66	3.00	1150
▽	66	4.00	1150

$$A = 13.6 \text{ IN.}^2$$

NOZZLE: 37T-3.3AR-CPA-RT/RC

JET NOISE POWER SPECTRA

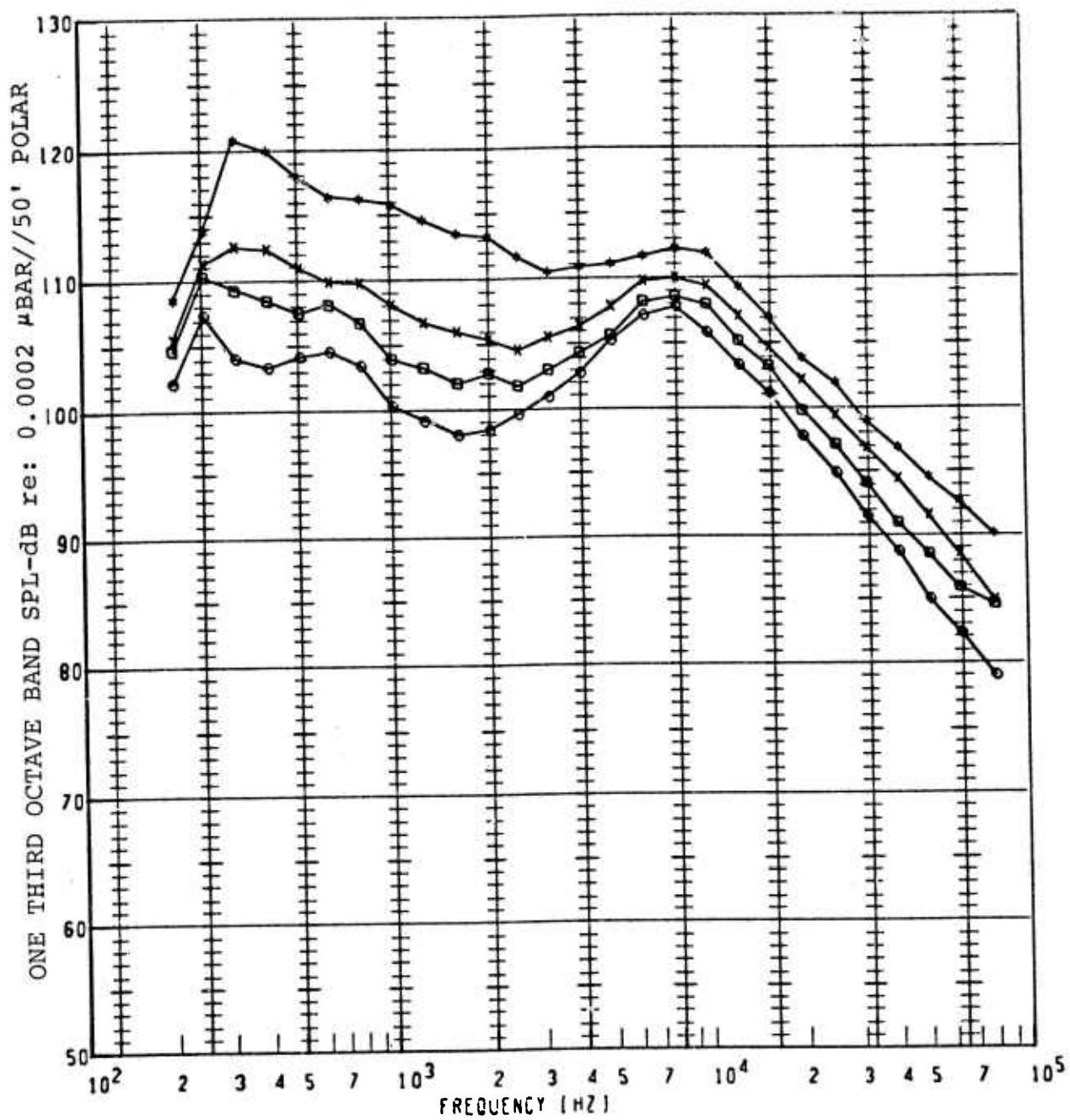


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL (dB)
○	66G	1150° F	2.000	110°	SOFP	114.2
□	66G	1150	2.500		SOFP	116.7
×	66G	1150	3.000		SOFP	118.8
*	66G	1150	4.000		SOFP	122.3

NOZZLE: 37T-3.3AR-CPA-RT/RC

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

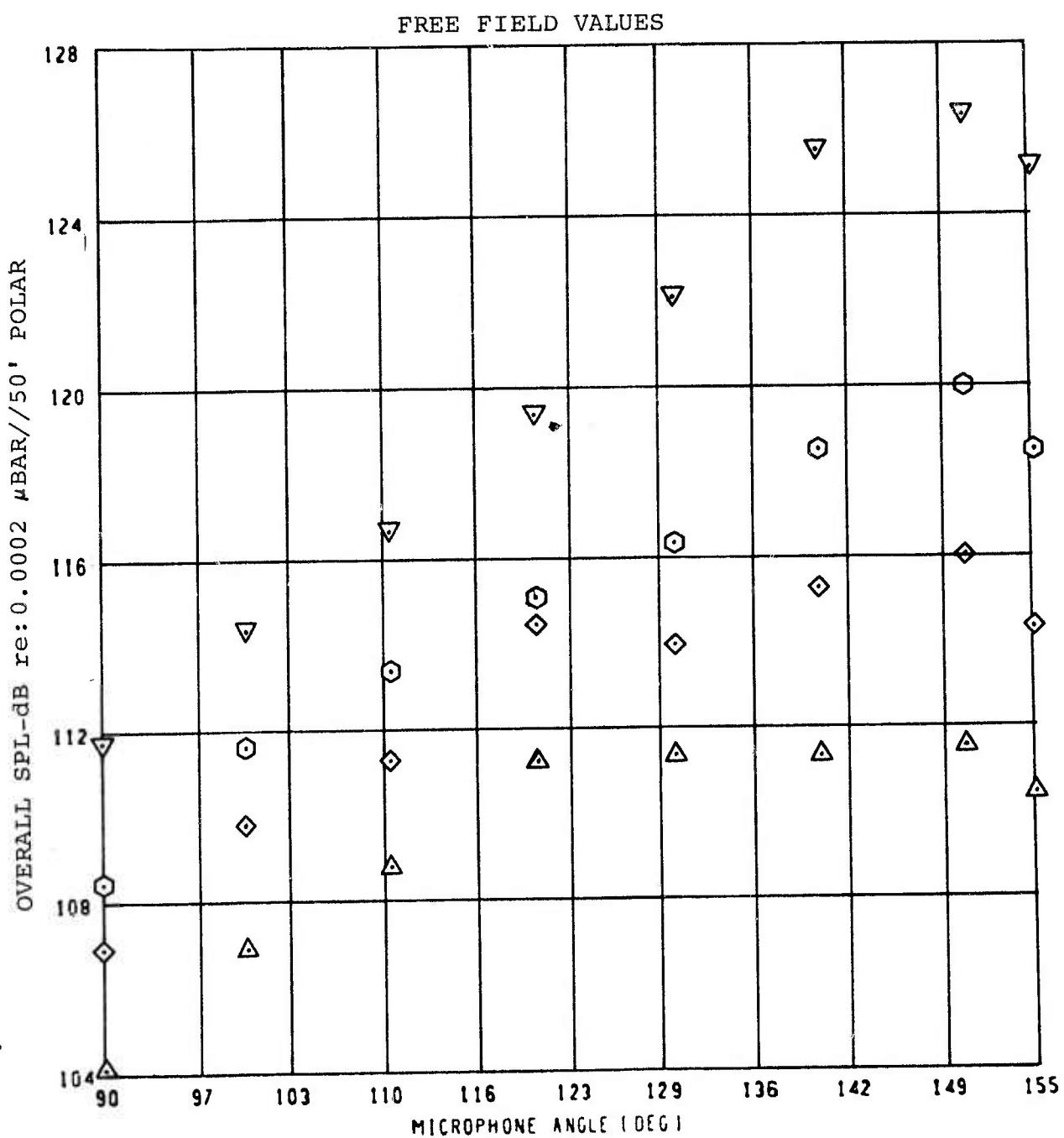
SPECTRA ARE FREE FIELD + 6dB



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL [dB]
•	66G	1150°F	2.000	130°	SOFP	117.0
□	66G	1150	2.500		SOFP	119.6
×	66G	1150	3.000		SOFP	122.0
*	66G	1150	4.000	↓	SOFP	127.9

NOZZLE: 37T-3.3AR-CPA-RT/RC

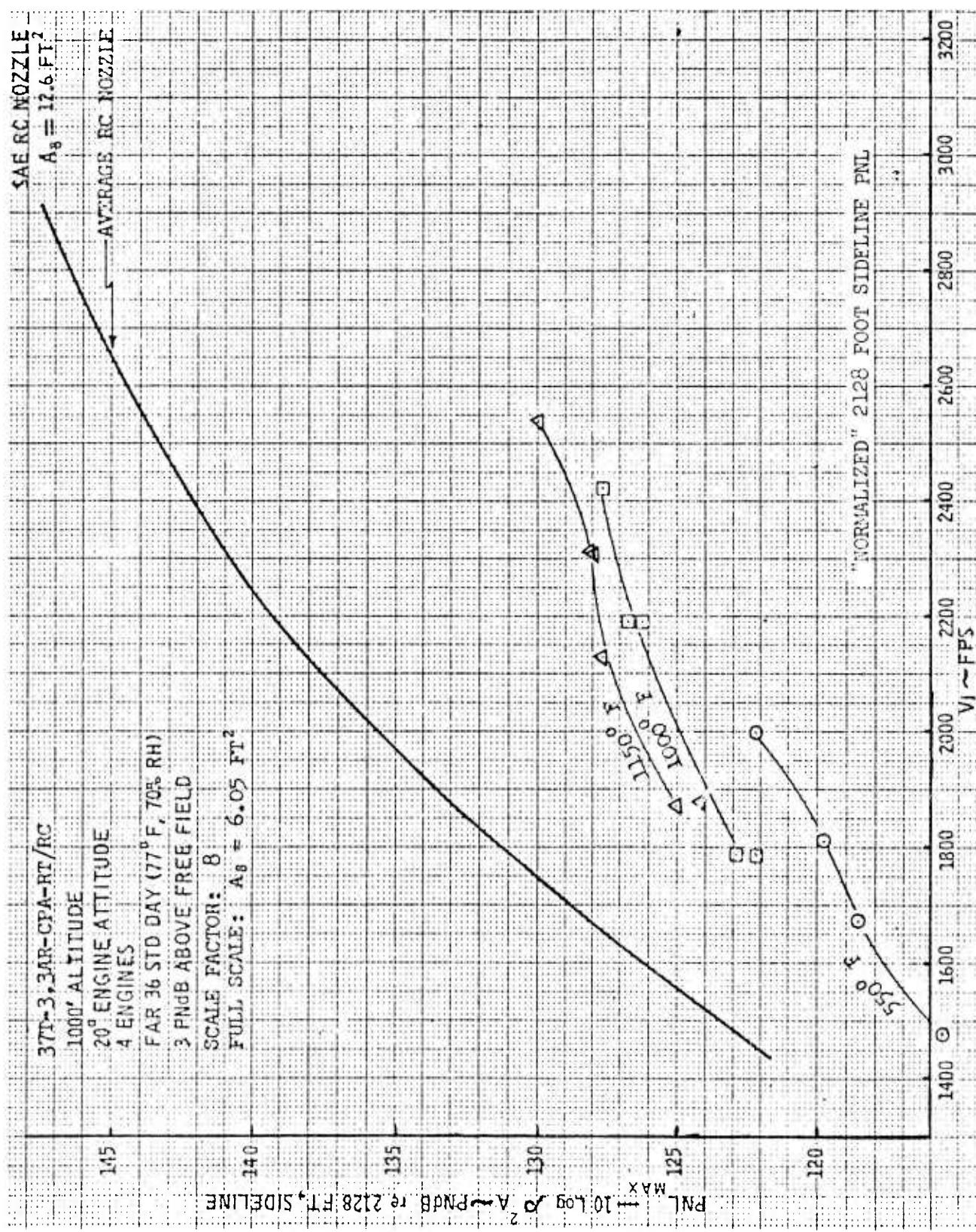
MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



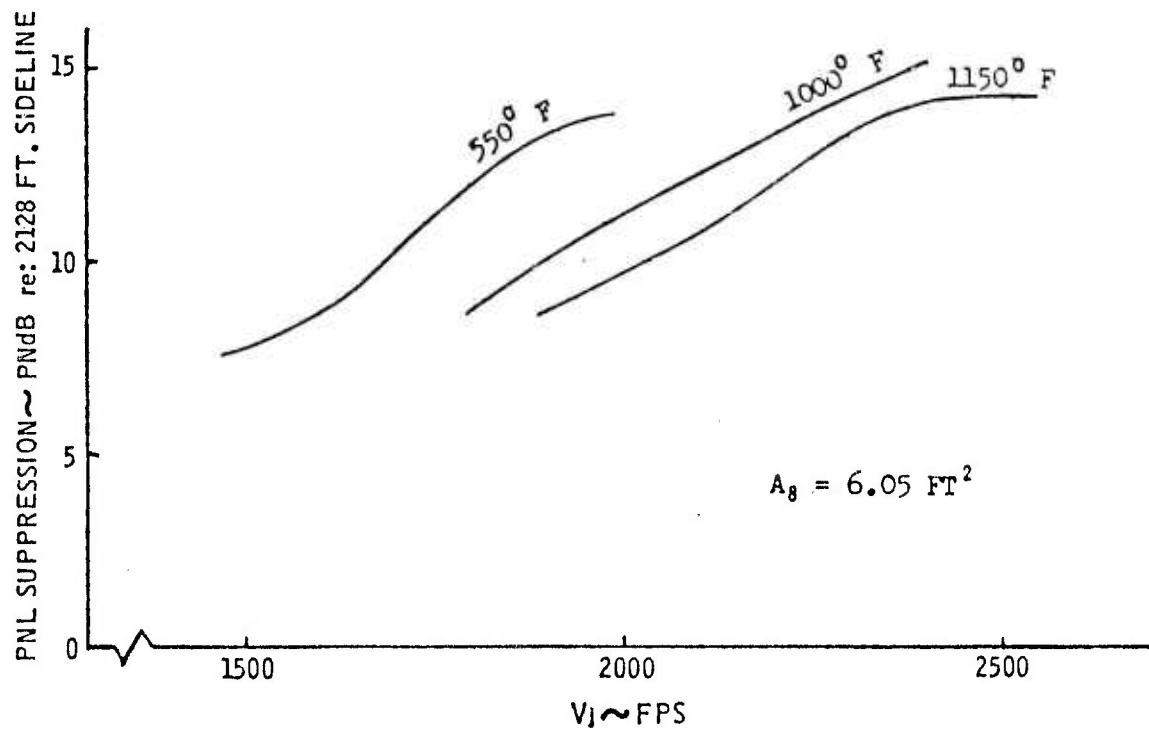
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	66	2.00	1150°F
◊	66	2.50	1150
○	66	3.00	1150
▽	66	4.00	1150

NOZZLE: 37T-3.3AR-CPA-RT/RC

OASPL BEAM PATTERNS

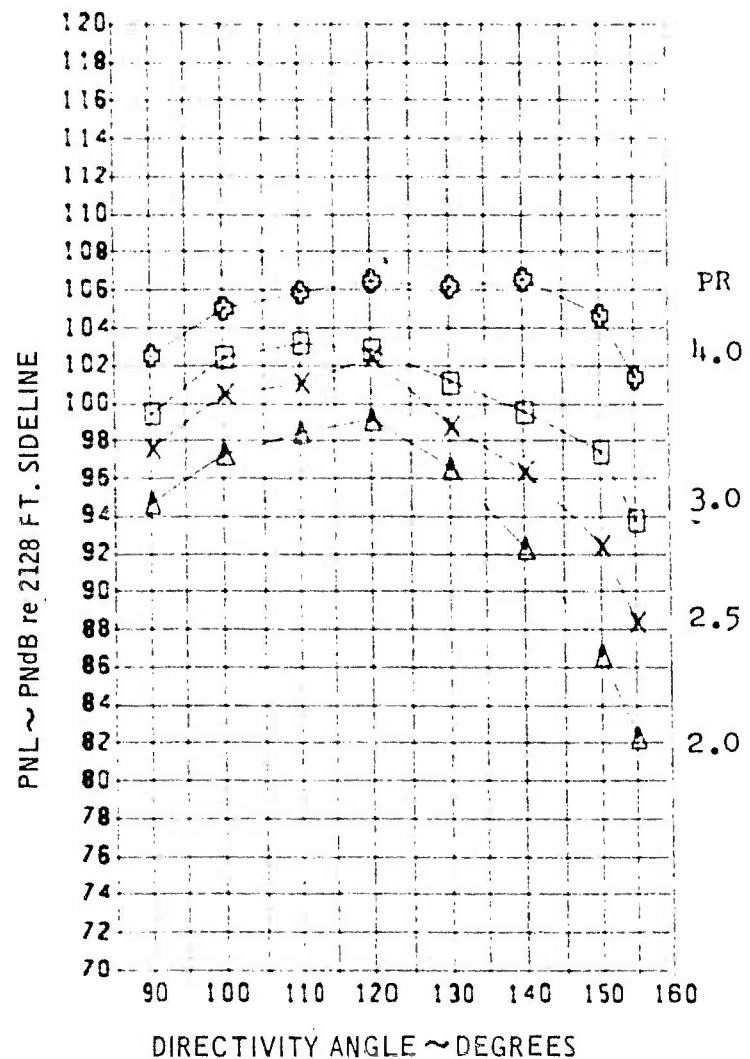


37T-3.3AR-CPA-RT/RC



PEAK PNL SUPPRESSION VALUES

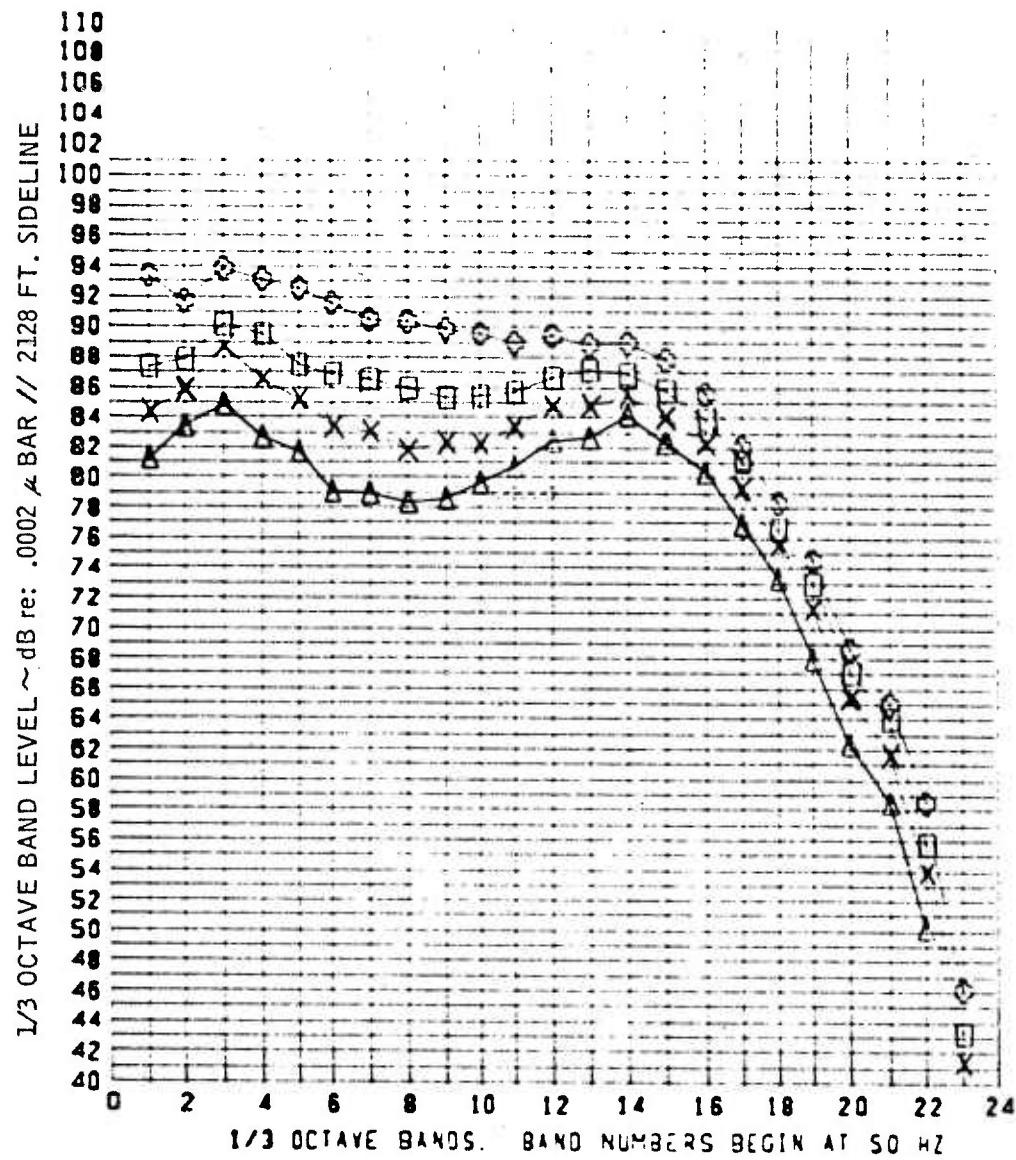
NOZZLE: 37T-3.3AR-CPA-RT/RC



$T_T = 1150^{\circ}\text{F}$ $A_8 = 6.05 \text{ FT}^2$ RUN: 66

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, SIDELINE = 2128 FT, 4 ENGINES
ANGLE: 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150° F

A₈ = 6.05 FT²

RUN: 66

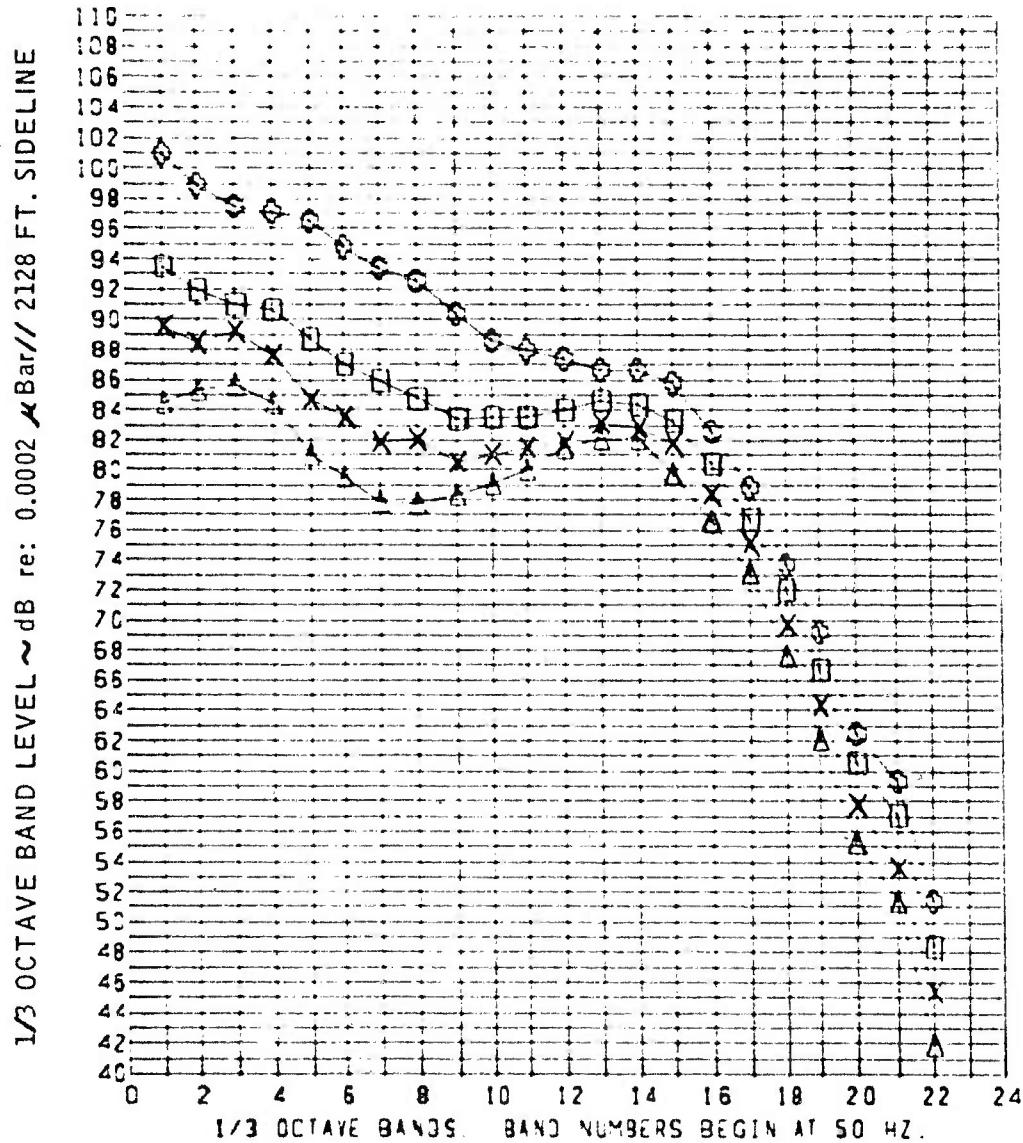
PR △ 2.0, ✕ 2.5, □ 3.0, + 4.0

NOZZLE: 37T-3.3AR-CPA-RT/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110° re: NOZZLE INLET AXIS

ALT = 1000FT, VEL = 0 FPS, S.L. = 2128 FT., 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150° F

A₈ = 6.05 FT²

RUN: 66

PR = \triangle 2.0, \times 2.5, \square 3.0, \blacksquare 4.0

NOZZLE: 37T-3.3AR-CPA-RT/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130° re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 37T-3.3AR-CPA-RT/RC

FACILITY: WALL ISOLATION FACILITY

DATE: August 25, 1972

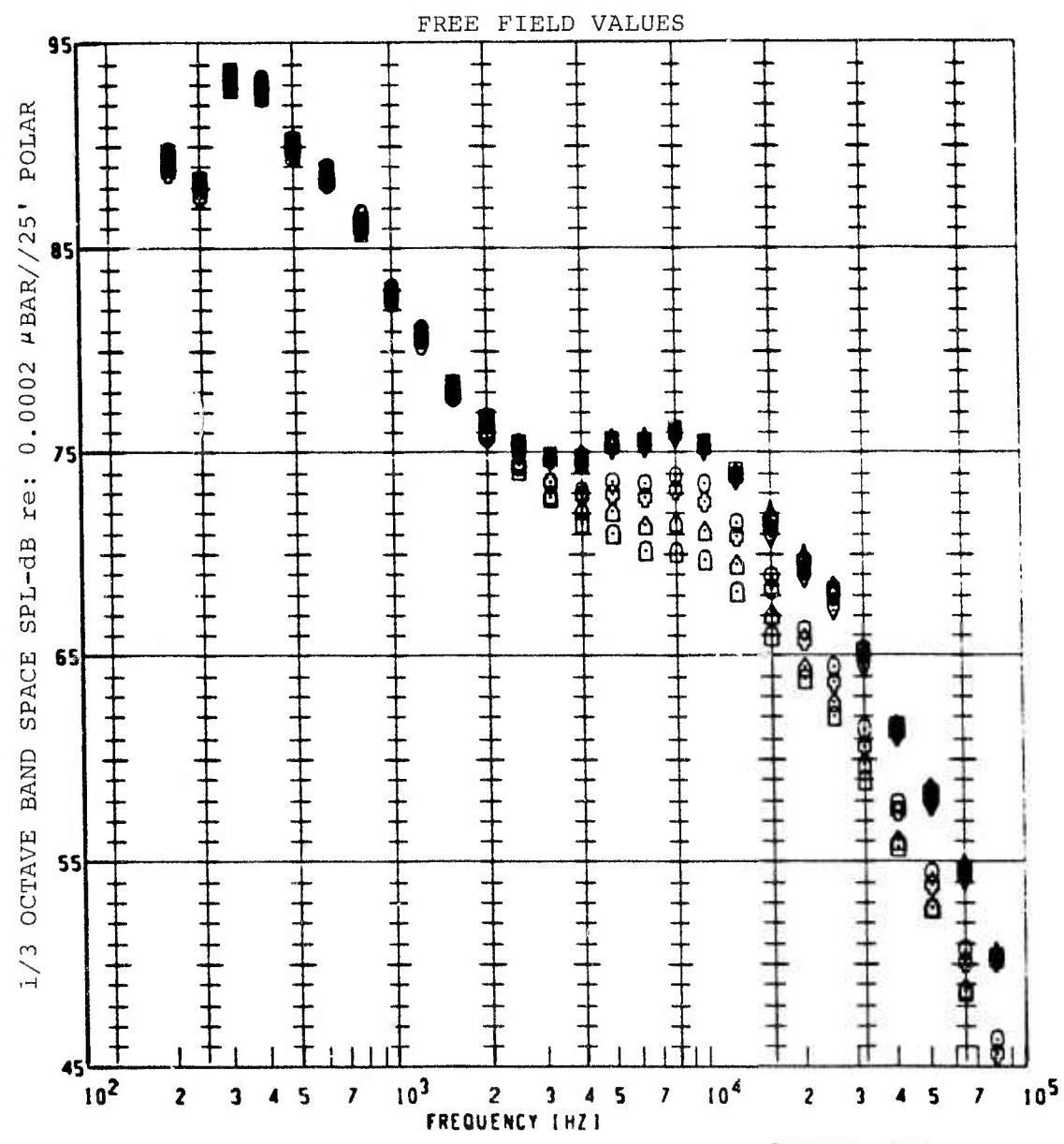
P_{AMB} = 30.05 in Hg **T_{AMB}** = 61°F **R.H.** = 82%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

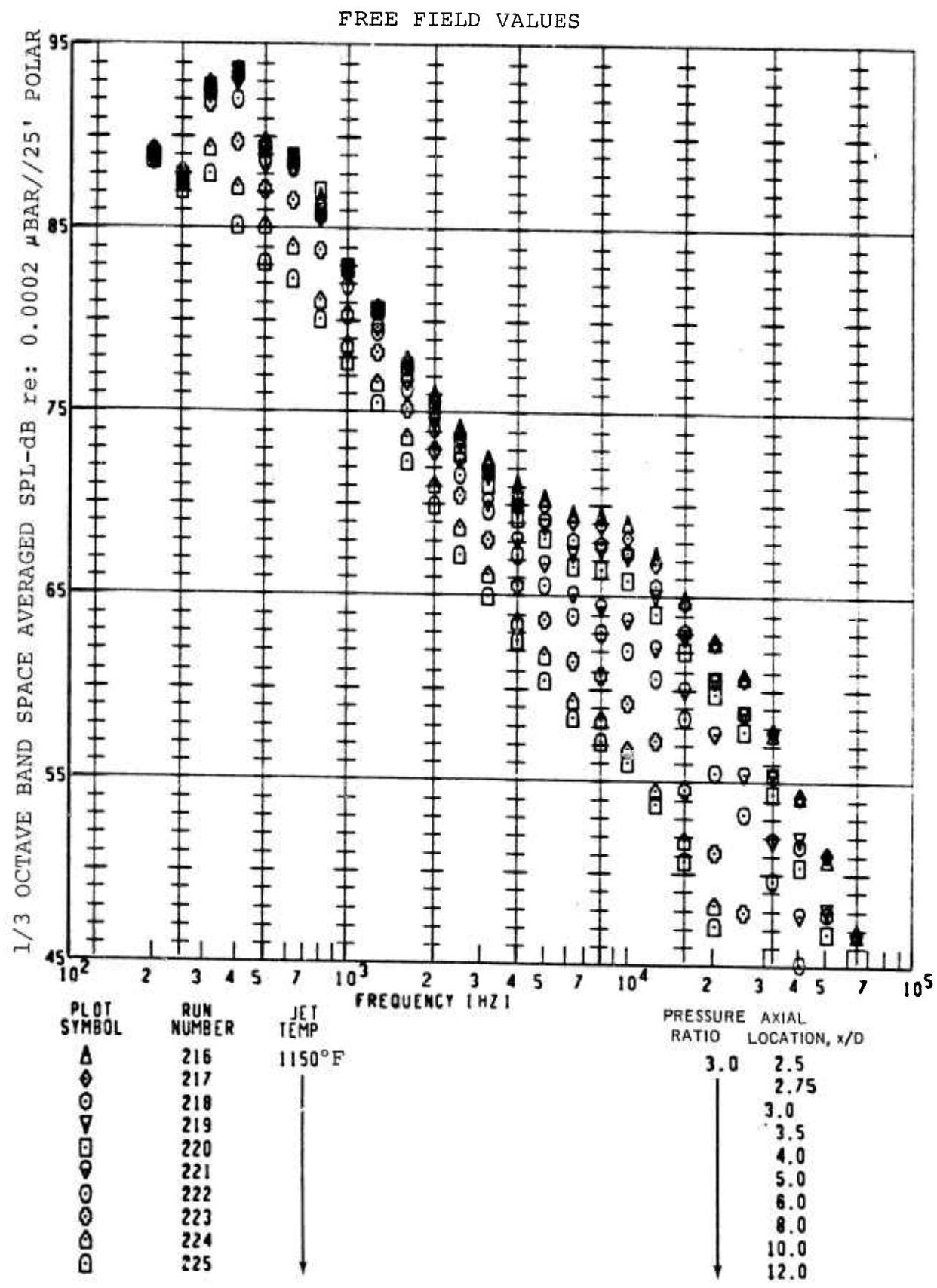
SCALE MODEL A₈ = 13.6 in.²

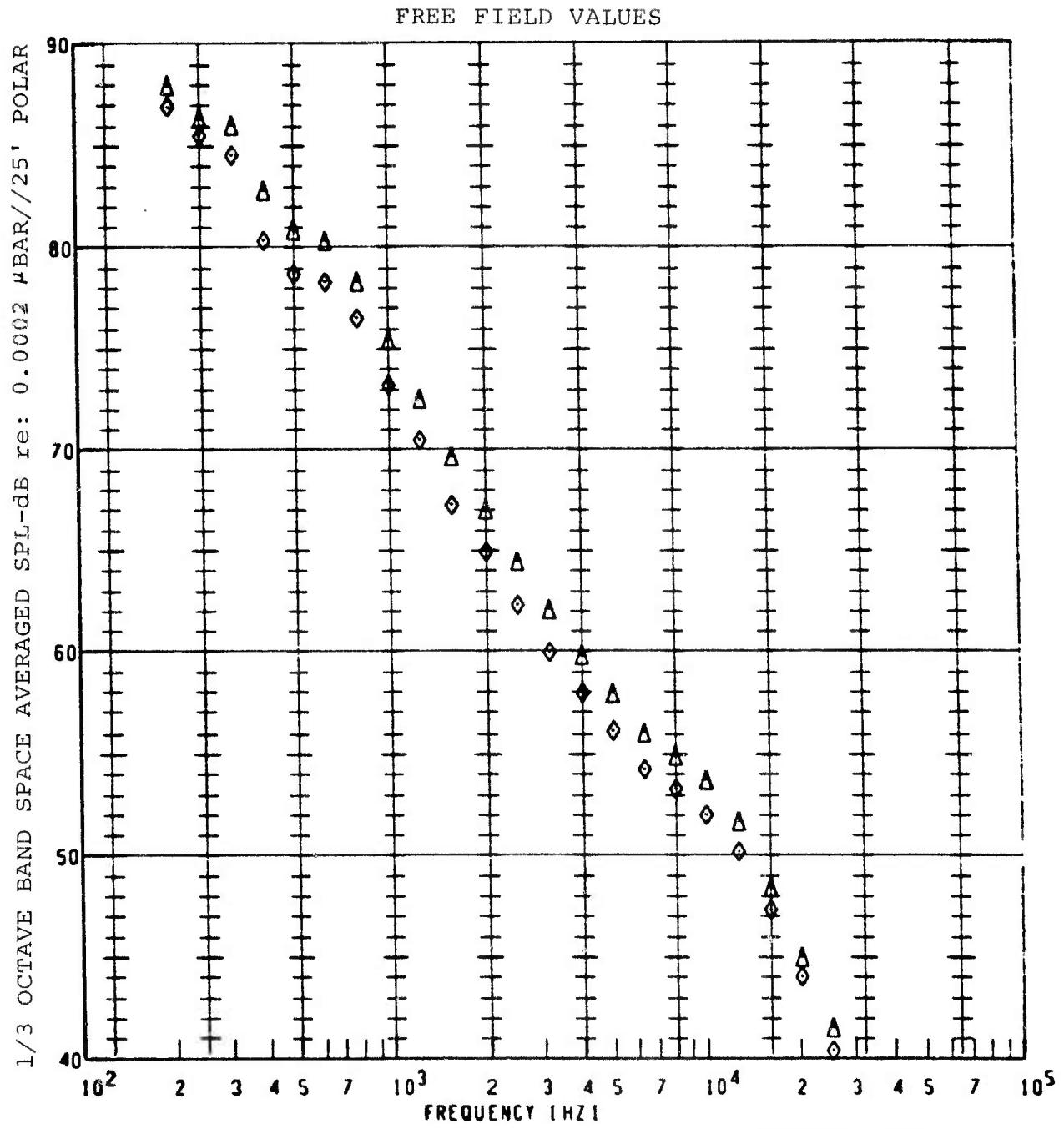
<u>RUN NO.</u>	<u>AXIAL LOCATION</u>	<u>IRIS DIA.</u>	<u>REMARKS</u>	<u>REF.</u>
206	0.0 x/D	14.3 in.		
207	0.25	11.3		
208	0.50	11.8		
209	0.75	11.8		
210	1.0	12.3		
211	1.25	11.5		
212	1.50	11.8		
213	1.75	12.0		
214	2.0	12.3		
215	2.25	12.5		
216	2.5	12.8		
217	2.75	13.0		
218	3.0	13.3		
219	3.5	13.5		
220	4.0	14.0		
221	5.0	15.0		
222	6.0	16.0		
223	8.0	18.0		
224	10.0	20.0		
225	12.0	22.0		
226	14.0	23.0		
227	16.0	25.0		

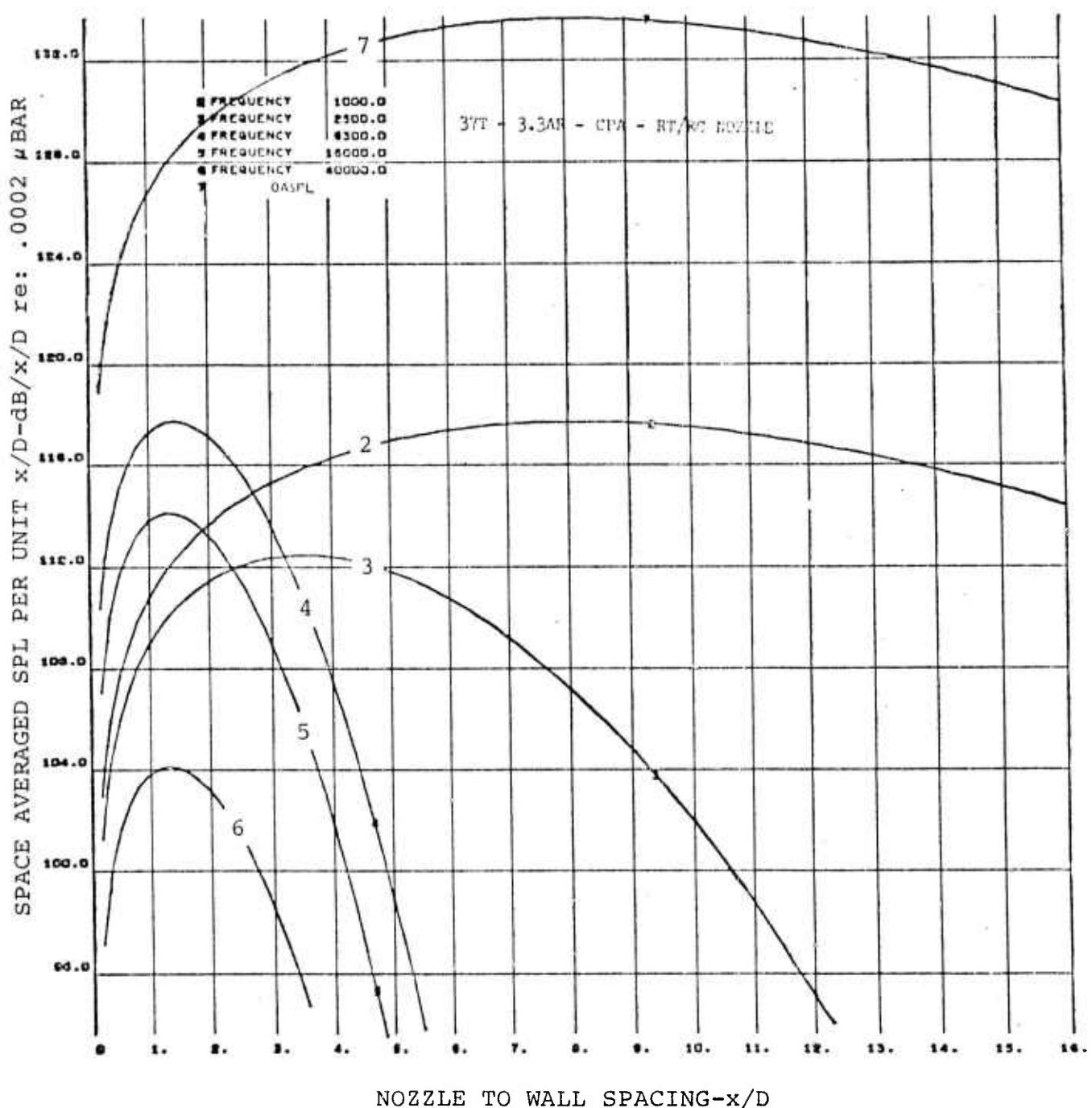
MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

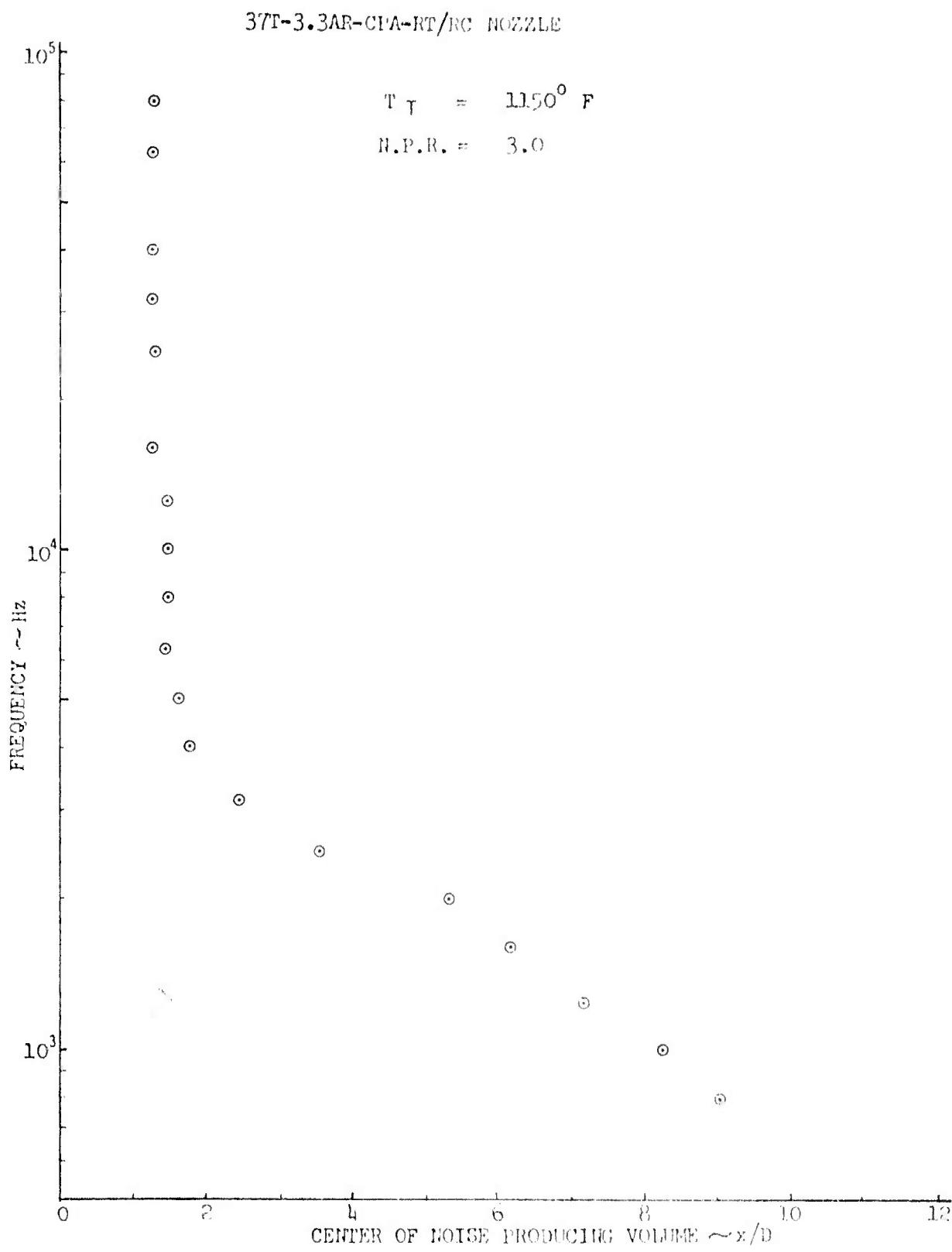


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
▲	206	1150°F	3.0	0.0
●	207			0.25
◆	208			0.5
◆	209			0.75
◆	210			1.0
◆	211			1.25
◆	212			1.5
◆	213			1.75
◆	214			2.0
◆	215			2.25

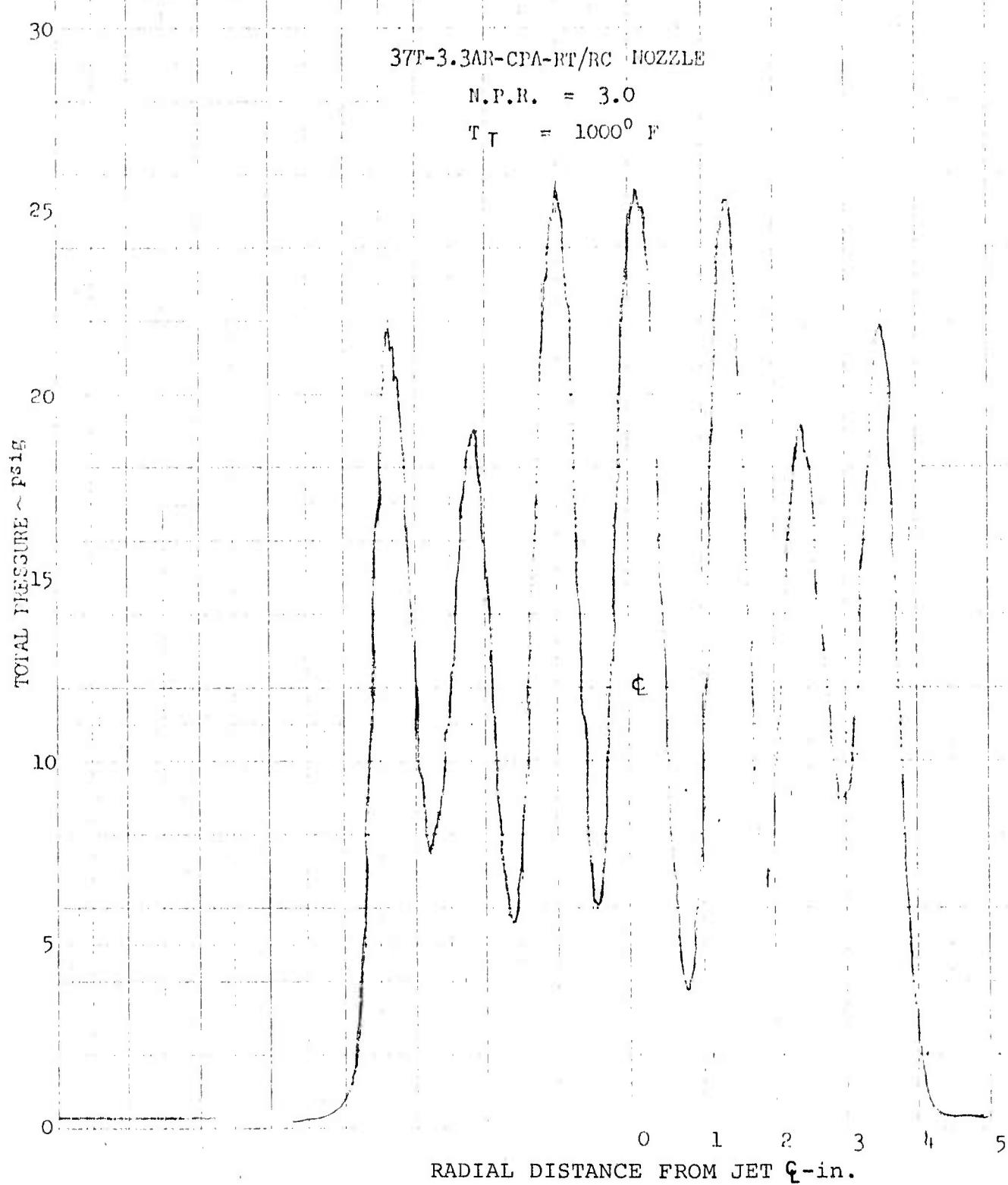


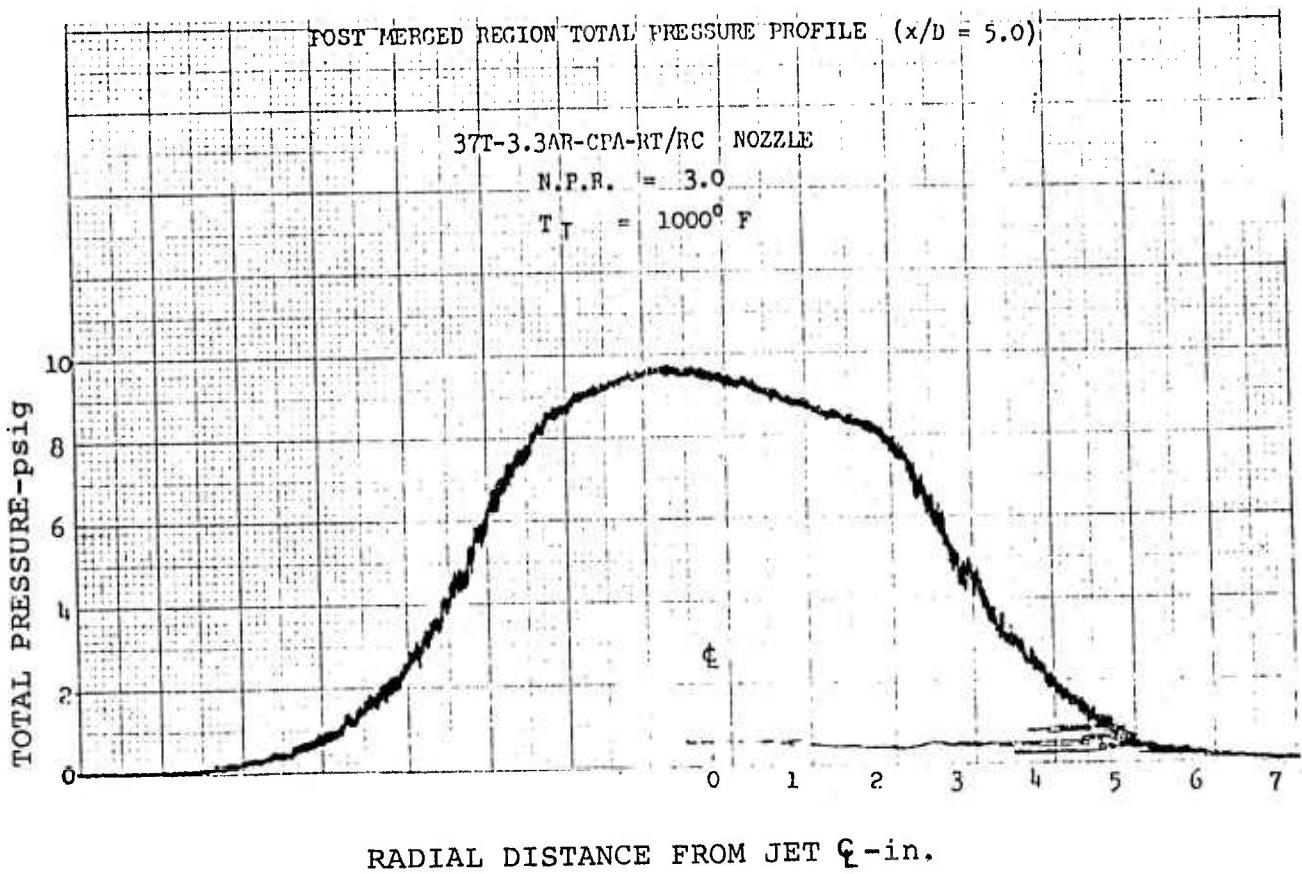


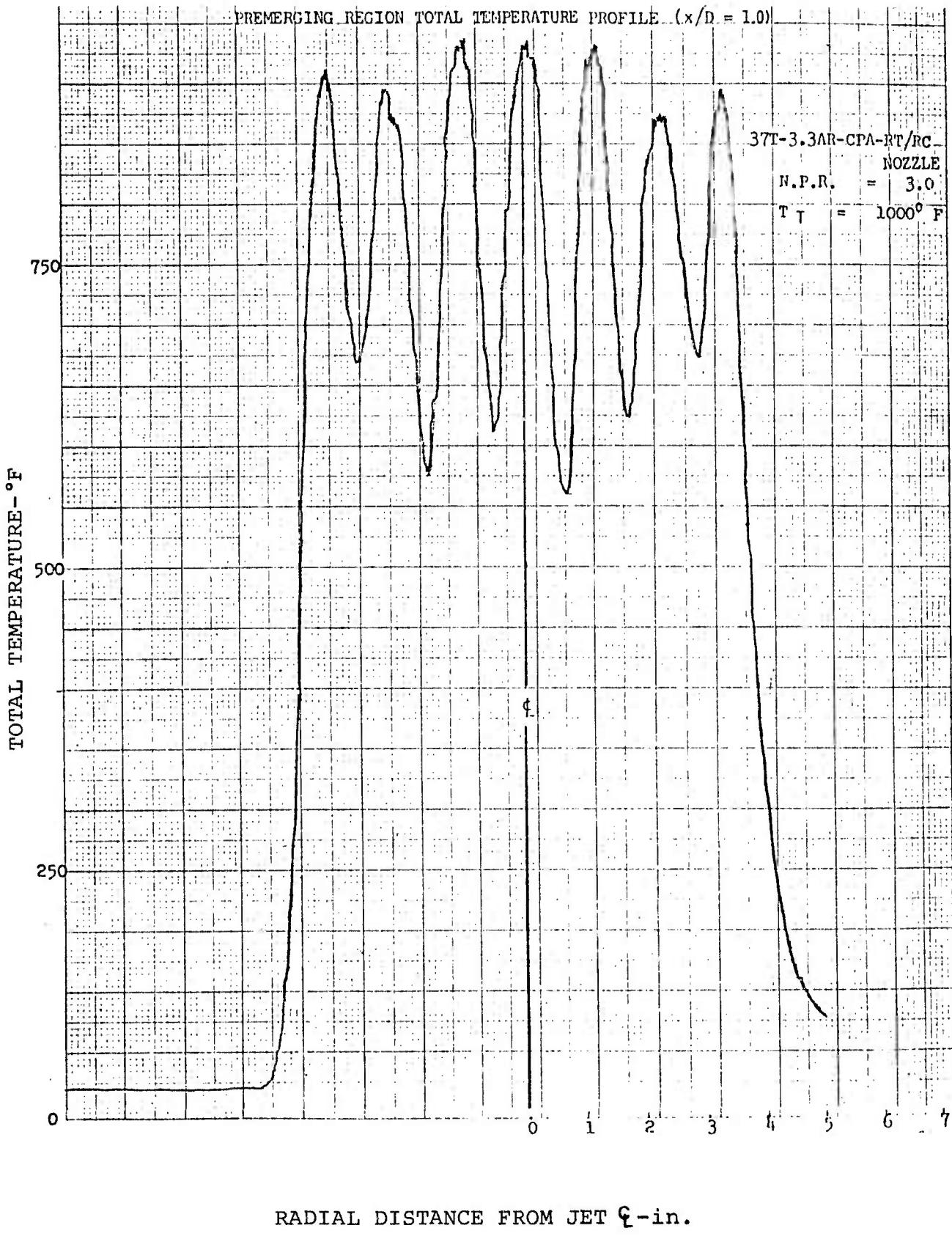


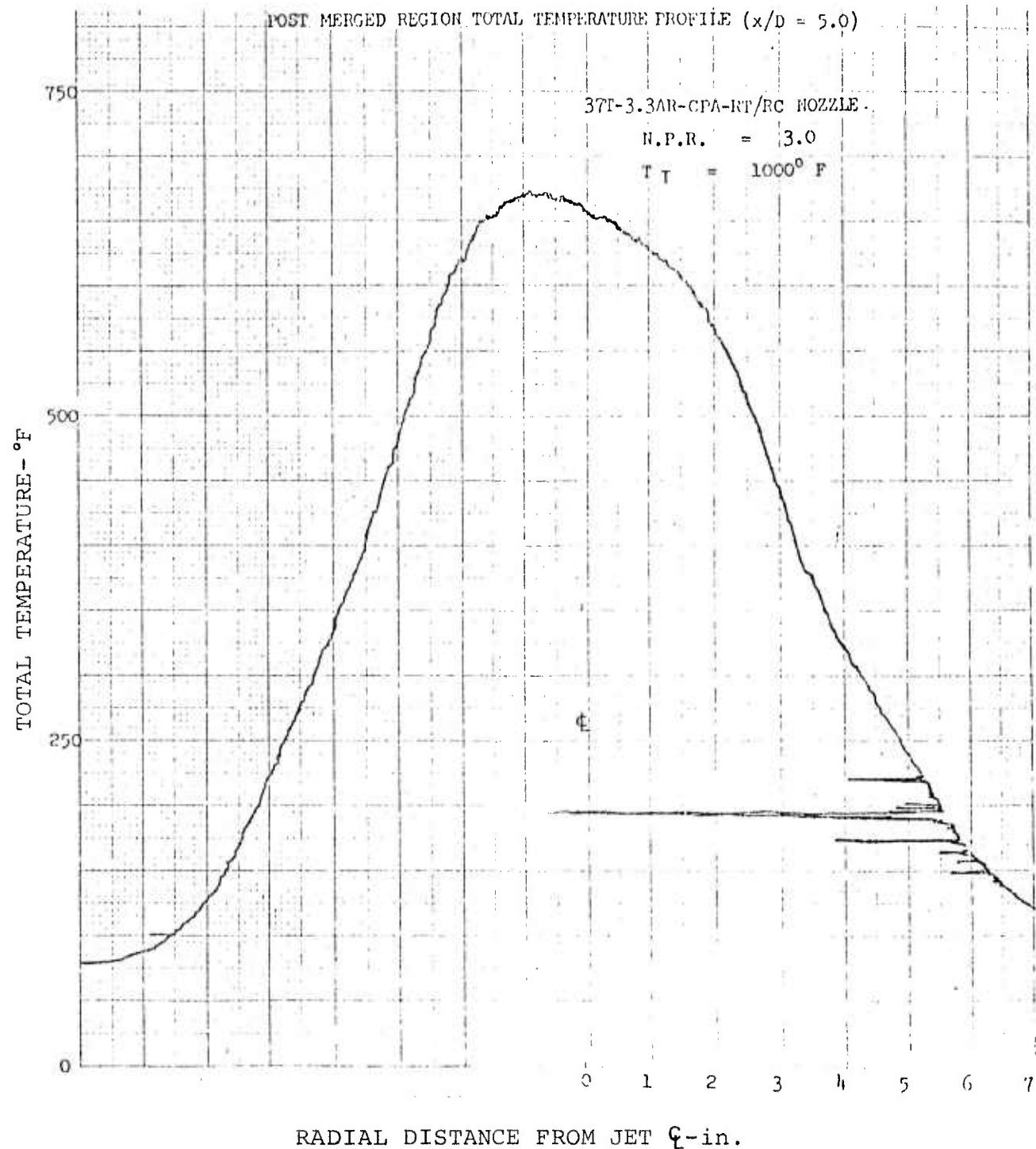


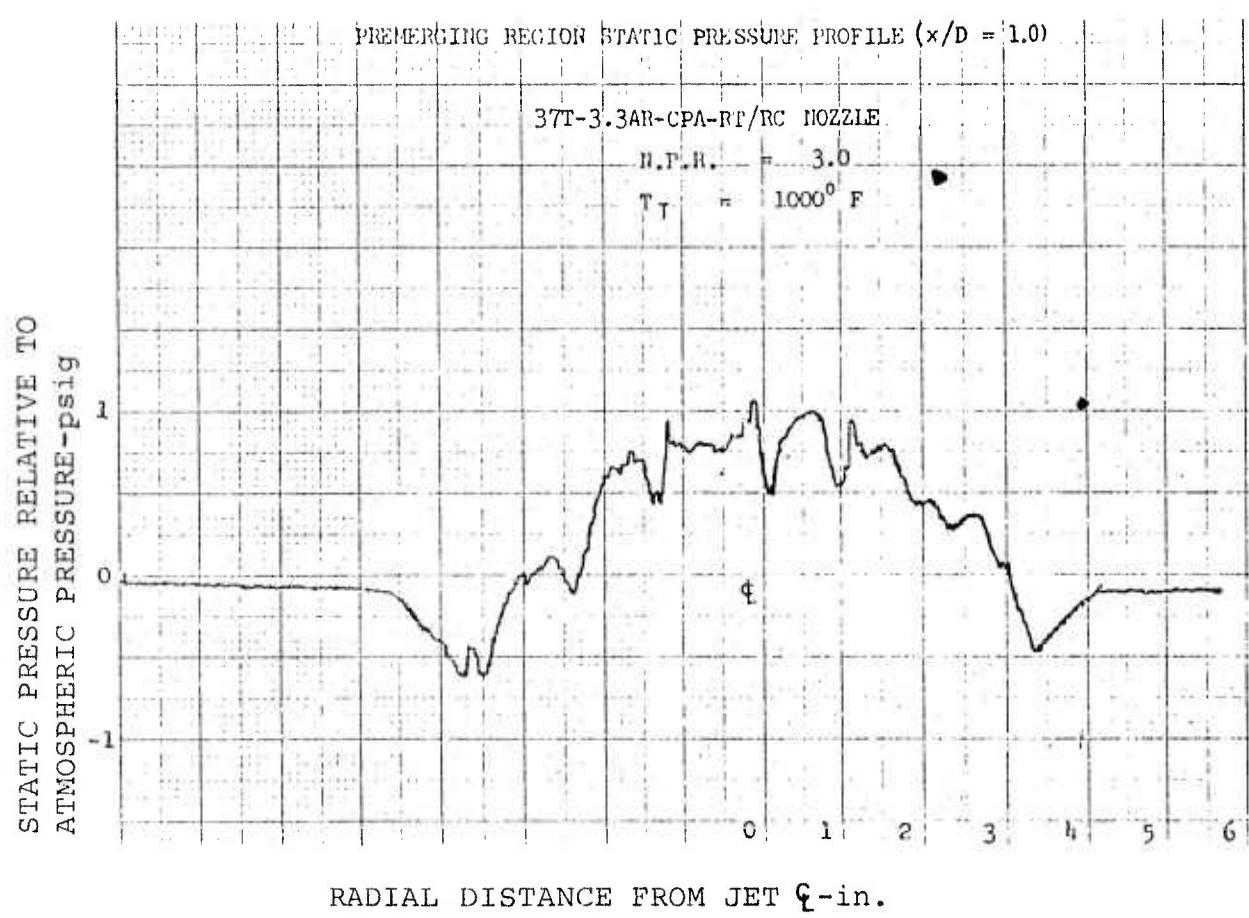
PREMERGING REGION TOTAL PRESSURE PROFILE ($x/D = 1.0$)

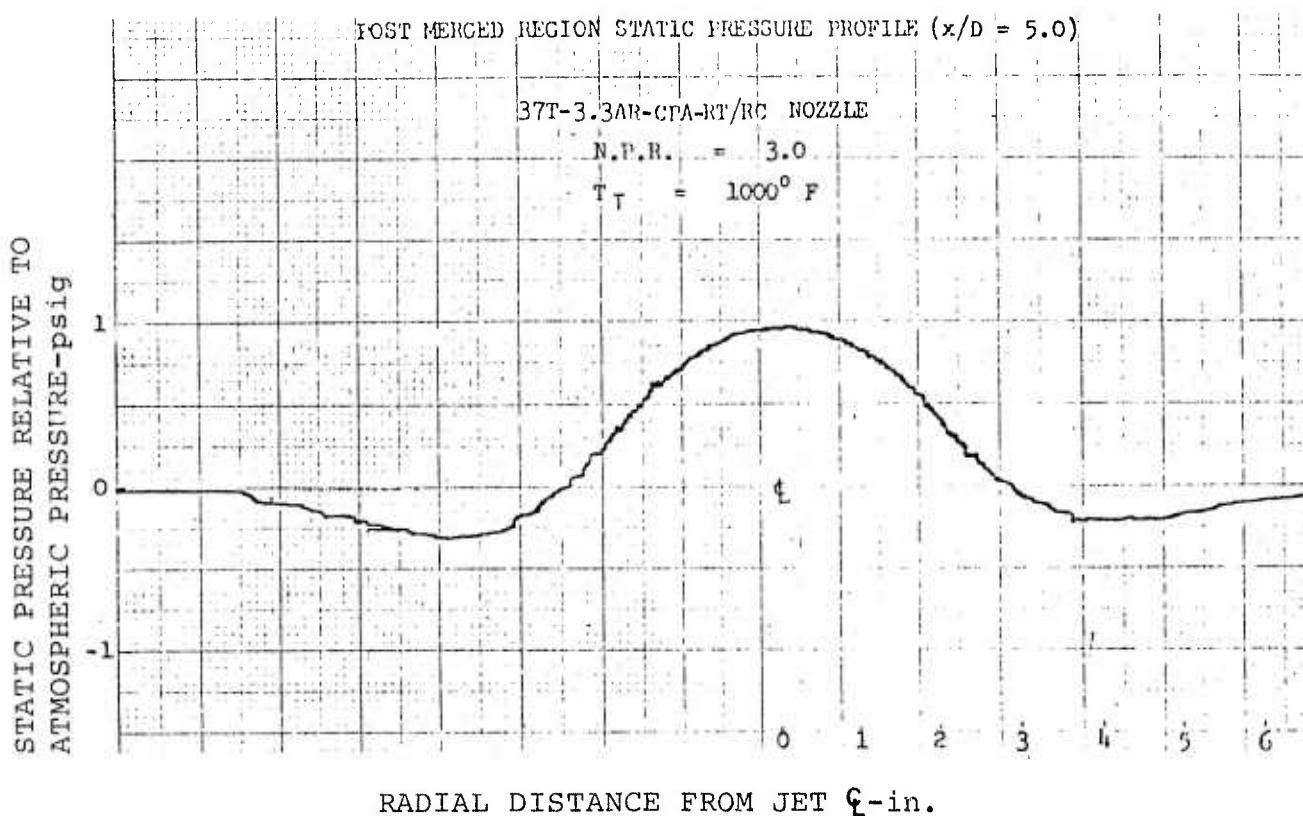


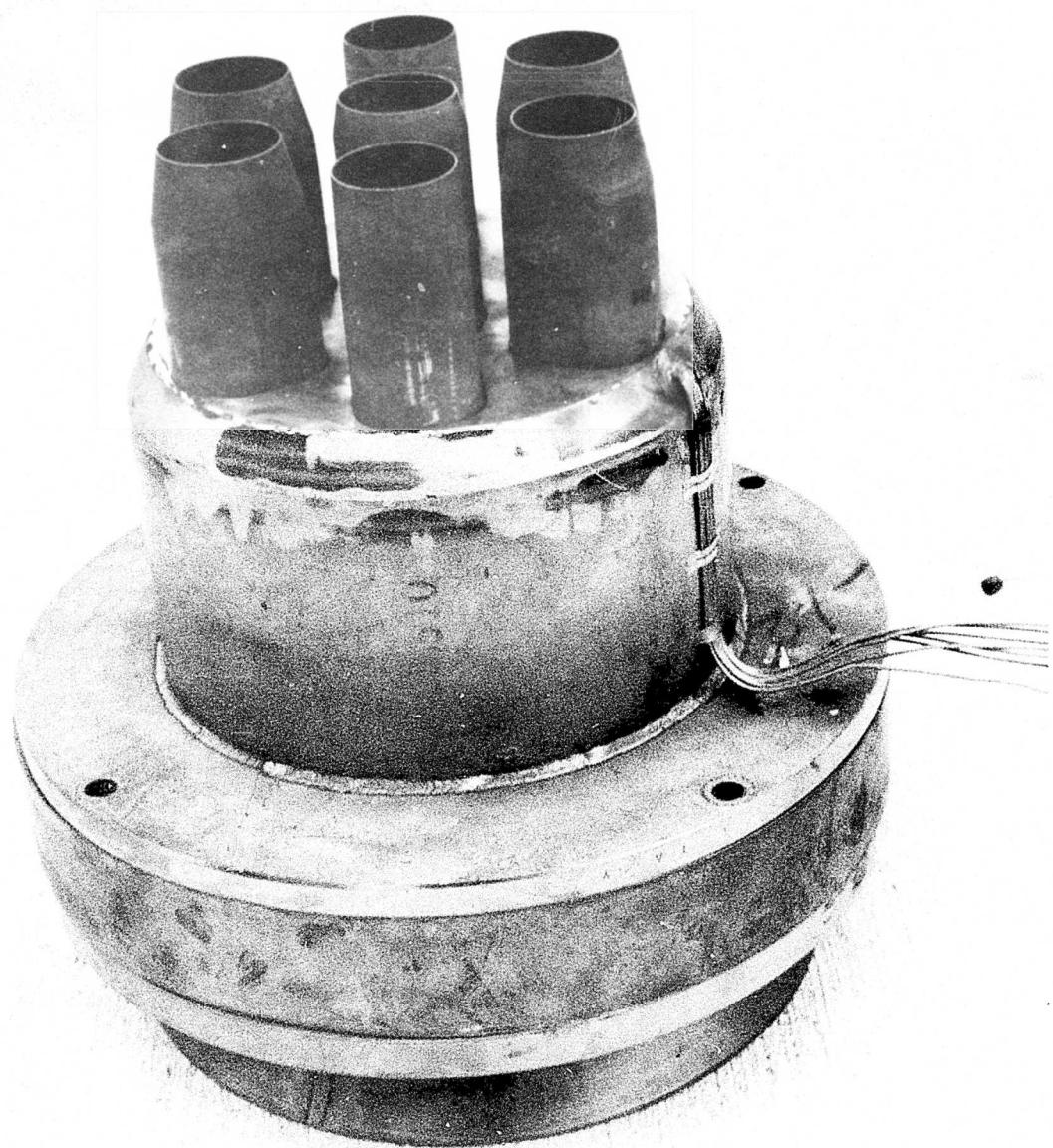




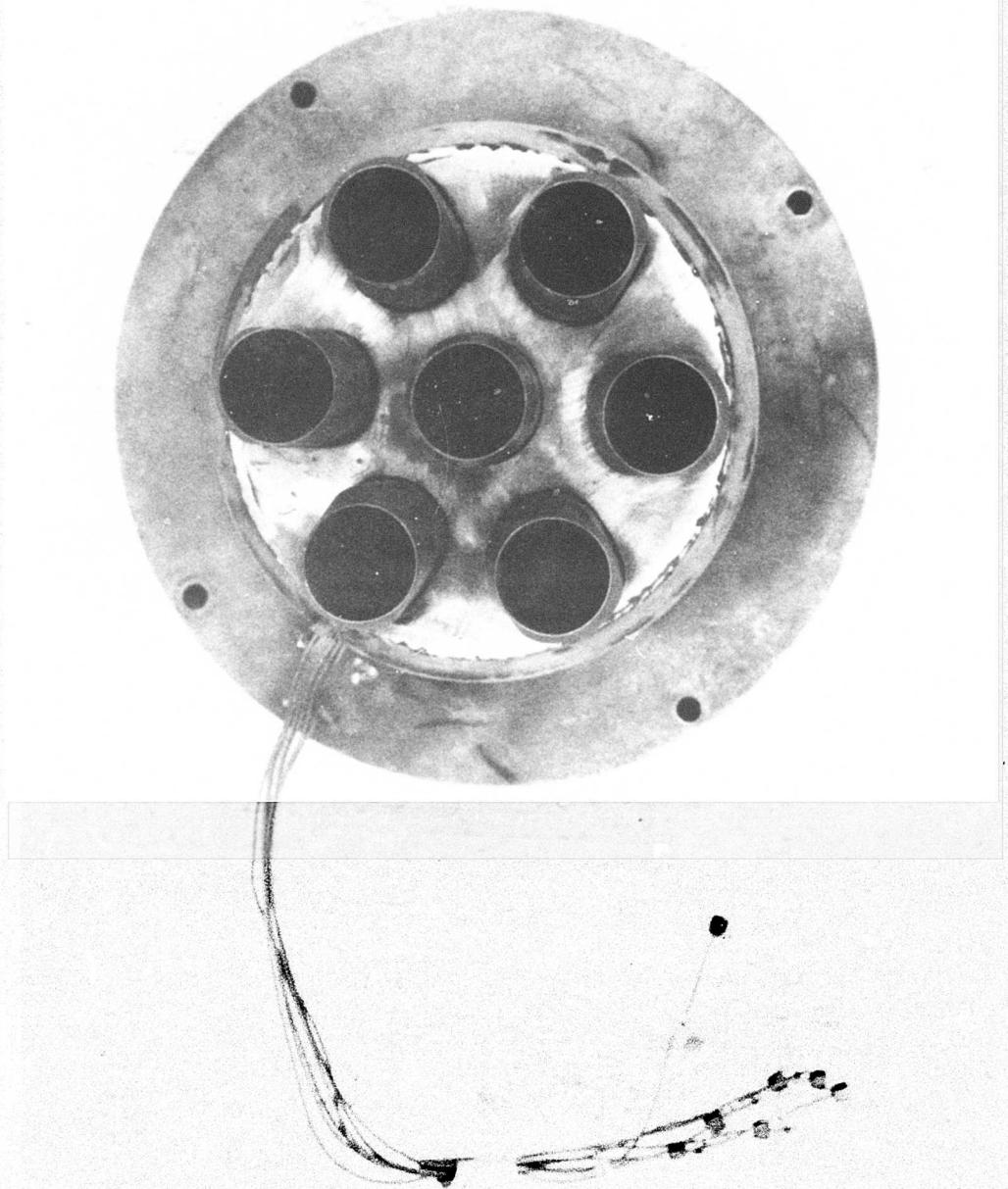




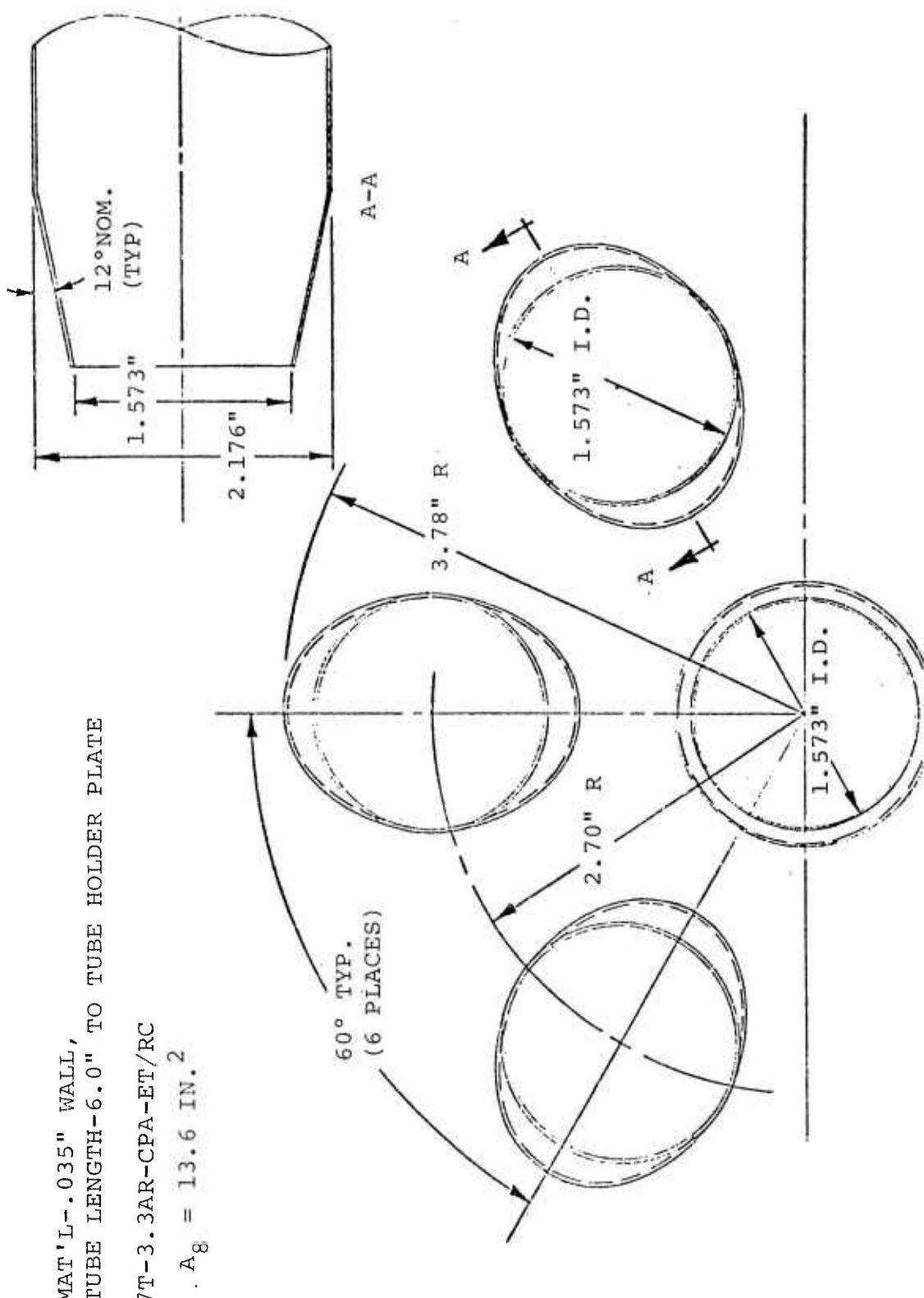




7T-3.3AR-CPA-ET/RC NOZZLE



7T-3.3AR-CPA-ET/RC NOZZLE



7 TUBE - AREA RATIO 3.3 ELLIPTICAL TUBES

TEST CONDITIONS

NOZZLE: 7T-3.3AR-CPA-ET/RC

FACILITY: HNTF

DATE: 6-11-73

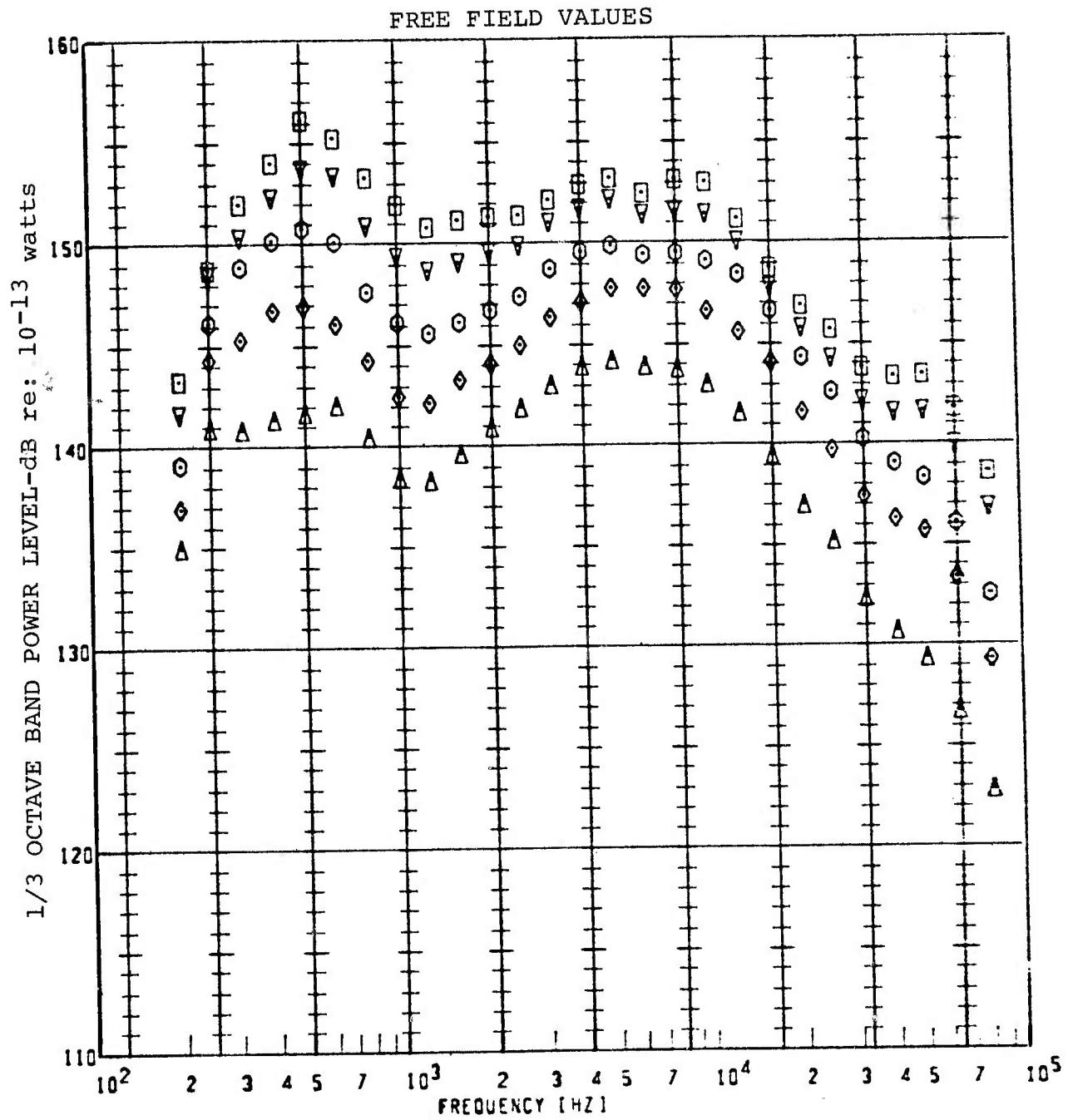
T_{AMB} = 73°F

R.H. = 36%

SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
8	2.0	1150°F	1875 fps	6" tube lengths	
"	2.5	"	2126		
"	3.0	"	2303		
"	3.5	"	2437		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

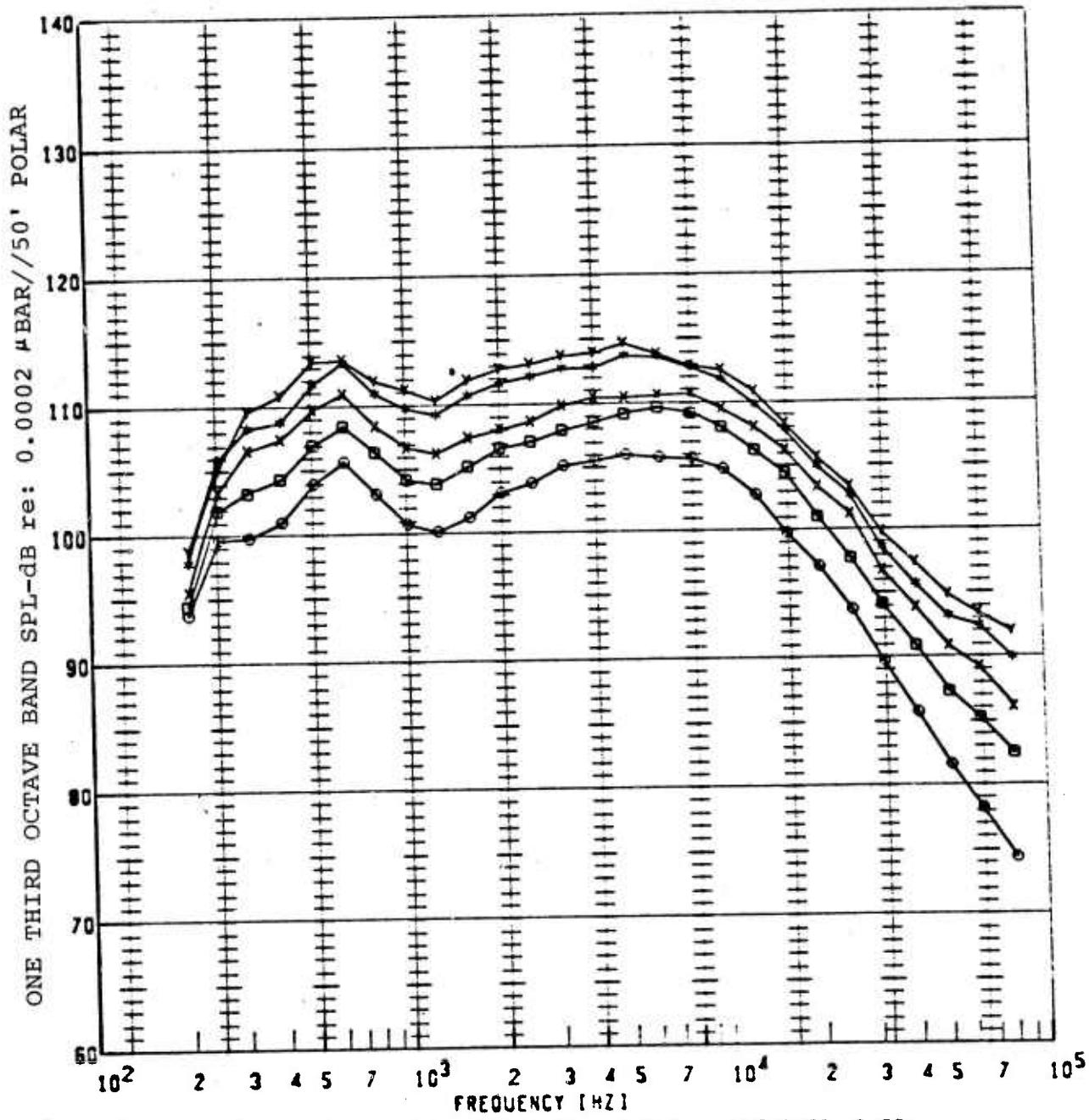


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
▲	008	2.00	1150 °F
◆	008	2.50	1150
○	008	3.00	1150
▽	008	3.50	1150
□	008	4.00	1150

NOZZLE: 7T-3.3AR-CPA-ET/RC

JET NOISE POWER SPECTRA

SPECTRA ARE FREE FIELD + 6dB

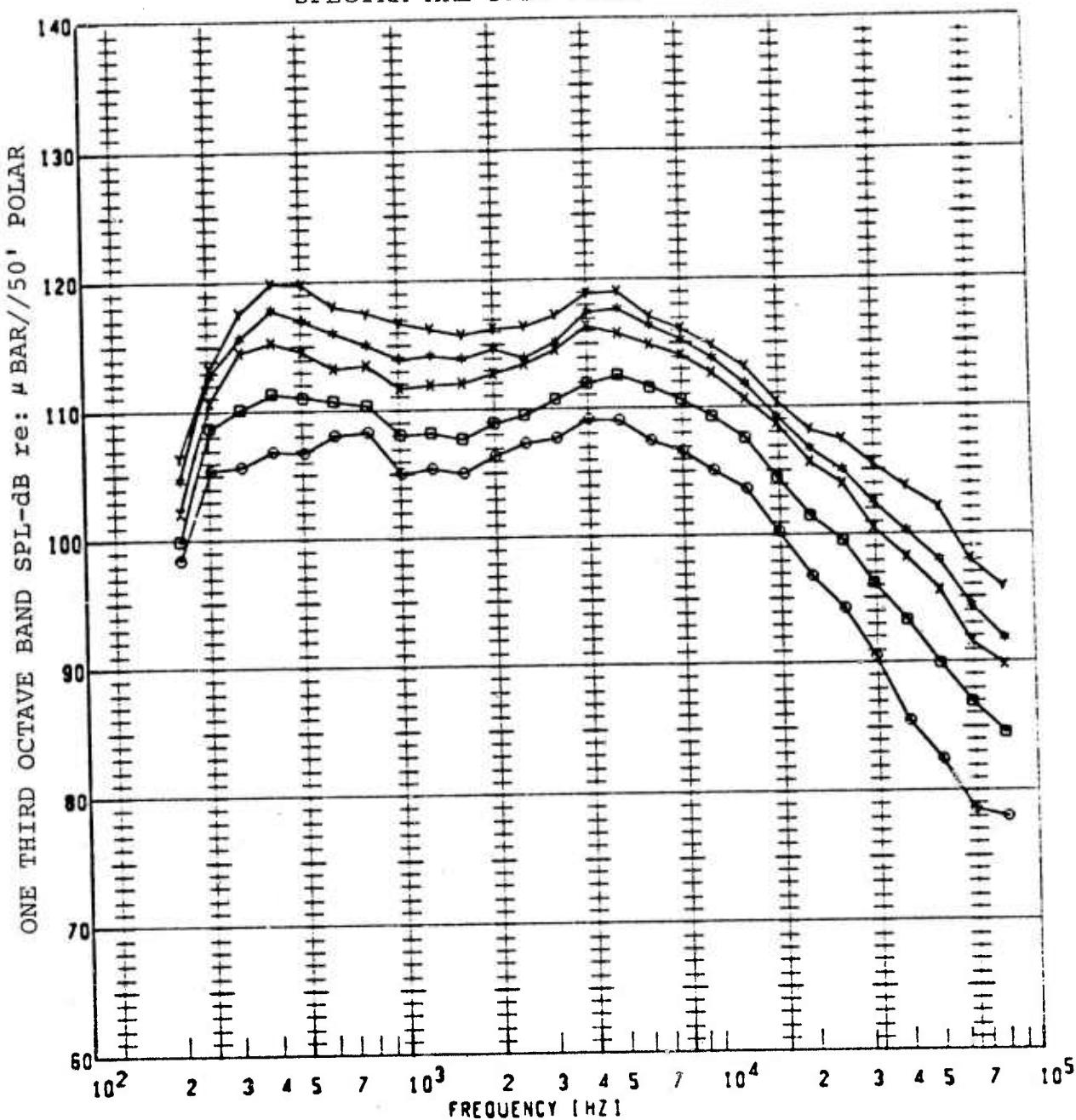


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	CASPL
○	008G	1150°F	2.000	110°	SOFP	116.5
□	008G	1150	2.500		SOFP	119.8
×	008G	1150	3.000		SOFP	121.7
*	008G	1150	3.500		SOFP	124.3
▽	008G	1150	4.000		SOFP	125.2

NOZZLE: 7T-3.3AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

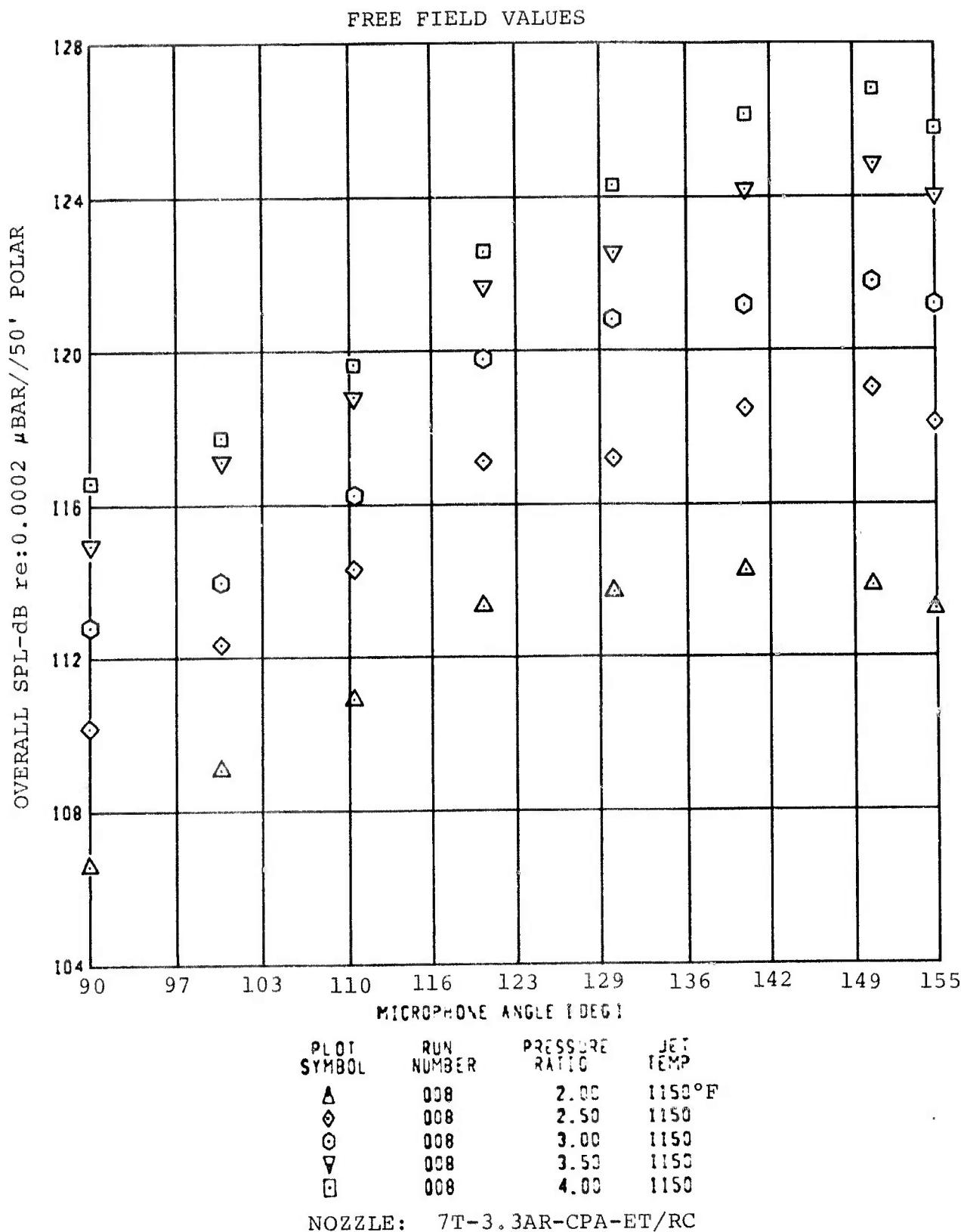
SPECTRA ARE FREE FIELD + 6dB



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [108]
○	008G	1150°F	2.000	130°	SOFP	119.5
□	038G	1150	2.500		SOFP	122.9
×	008G	1150	3.000		SOFP	126.5
*	008G	1150	3.500	↓	SOFP	128.2
◊	008G	1150	4.000		SOFP	129.9

NOZZLE: 7T-3.3AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



TT-3.3AR-CPA-ET/RC

1000' ALTITUDE

20° ENGINE ATTITUDE

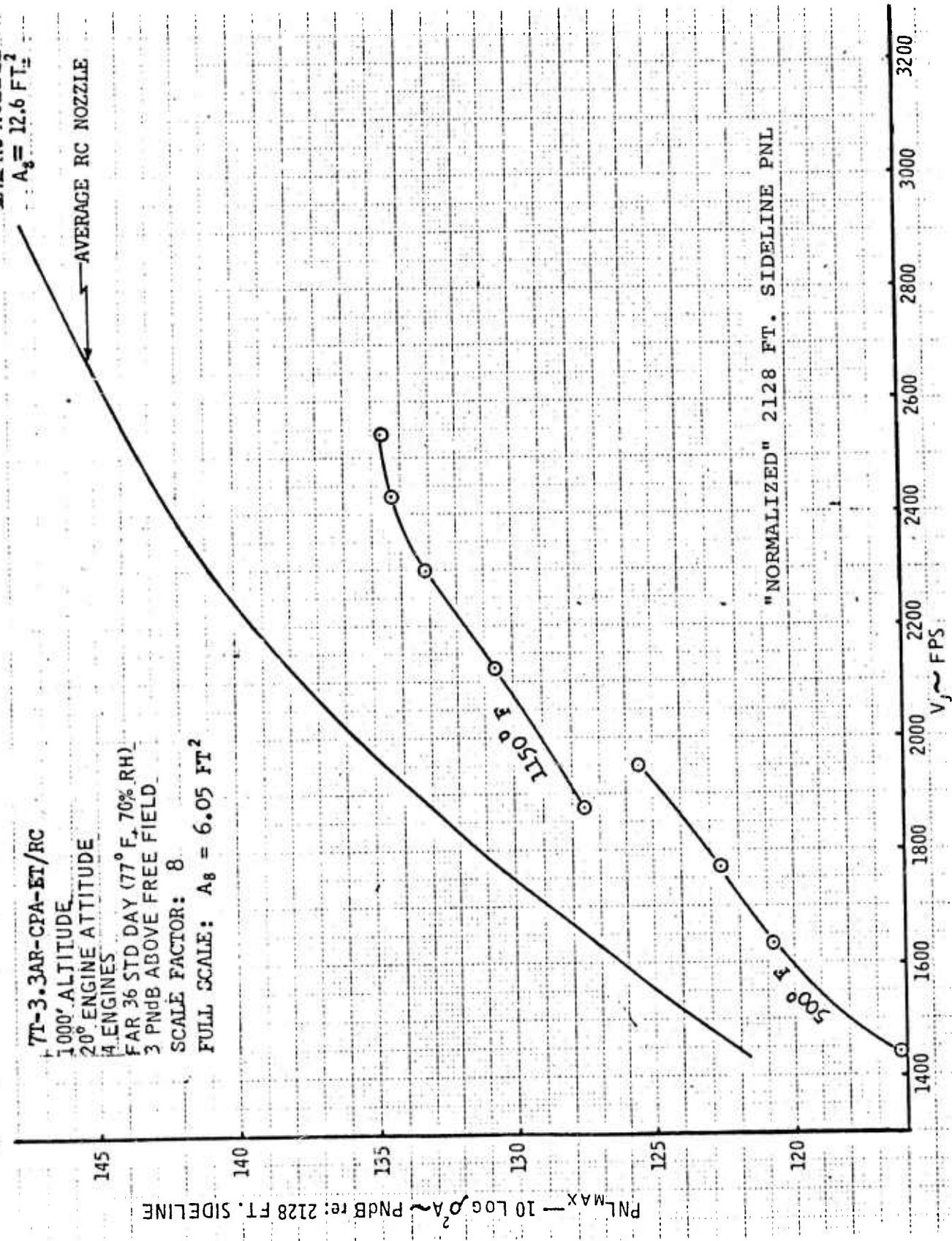
4 ENGINES
FAR 36 STD DAY (77° F, 76% RH)
3 PNdB ABOVE FREE FIELD

SCALE FACTOR: 8

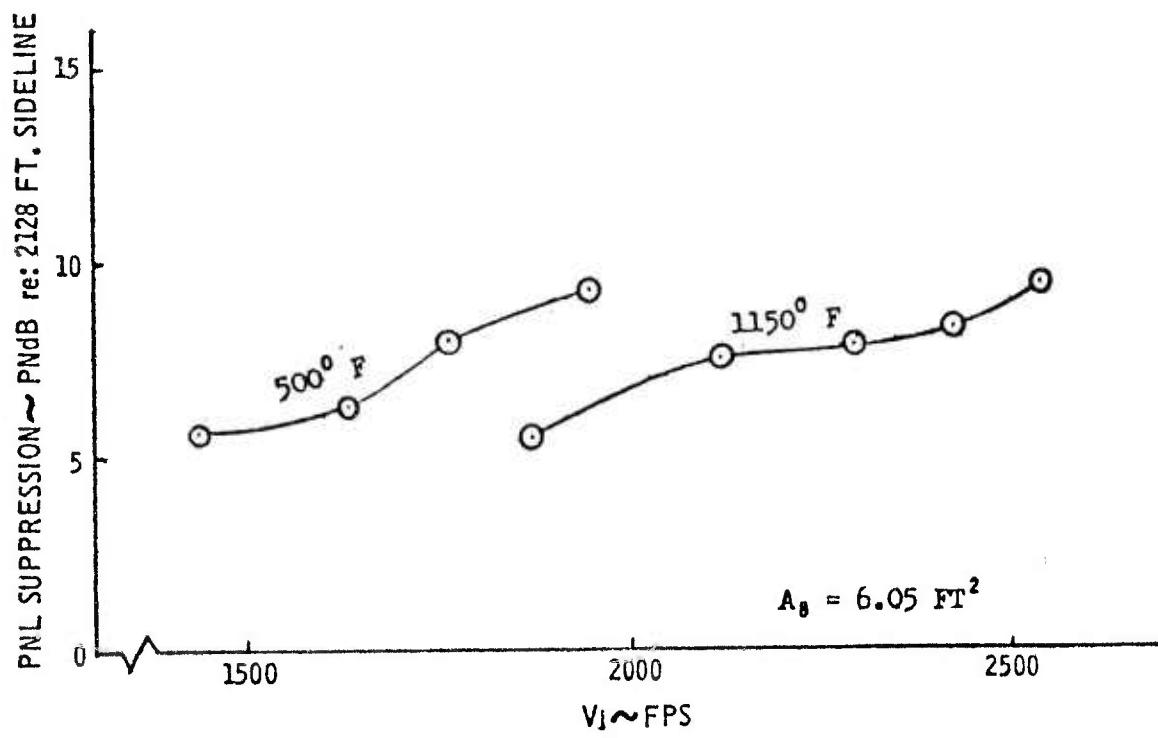
FULL SCALE: $A_s = 6.05 \text{ FT}^2$

SAE RC NOZZLE
 $A_s = 12.6 \text{ FT}^2$

AVERAGE RC NOZZLE

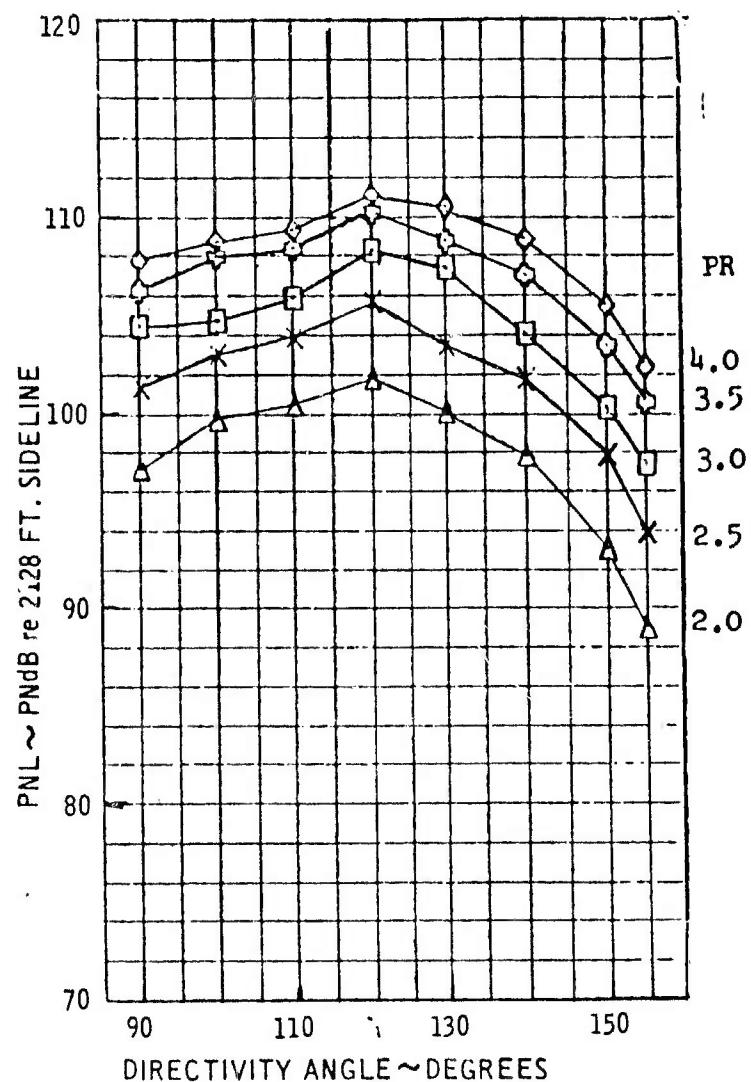


7T-3.3AR-CPA-ET/RC



PEAK PNL SUPPRESSION VALUES

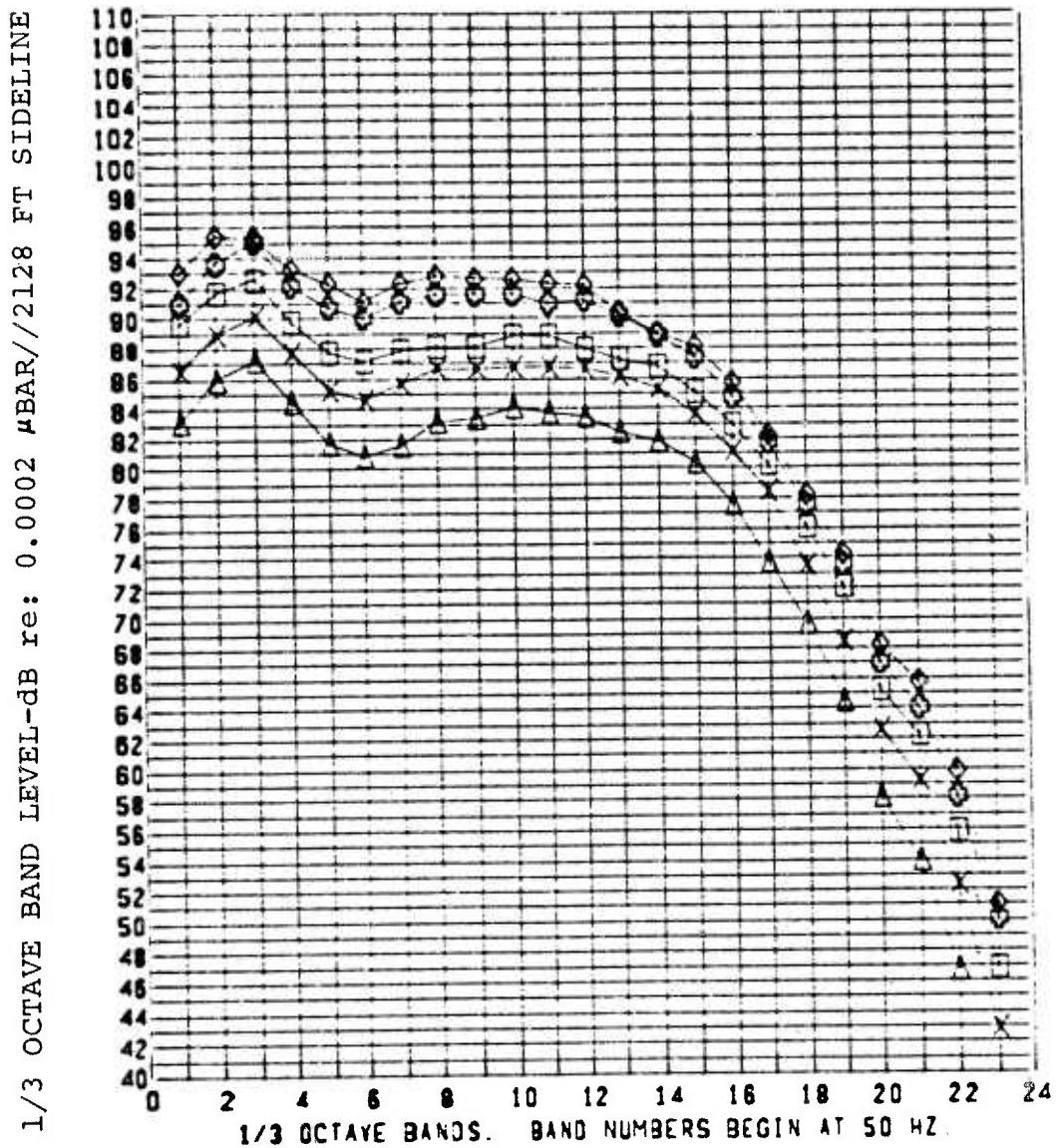
NOZZLE: 7T-3.3AR-CPA-RT/RC



RUN 008
TT = 1150⁰ F A8 = 6.05 FT²

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
 ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



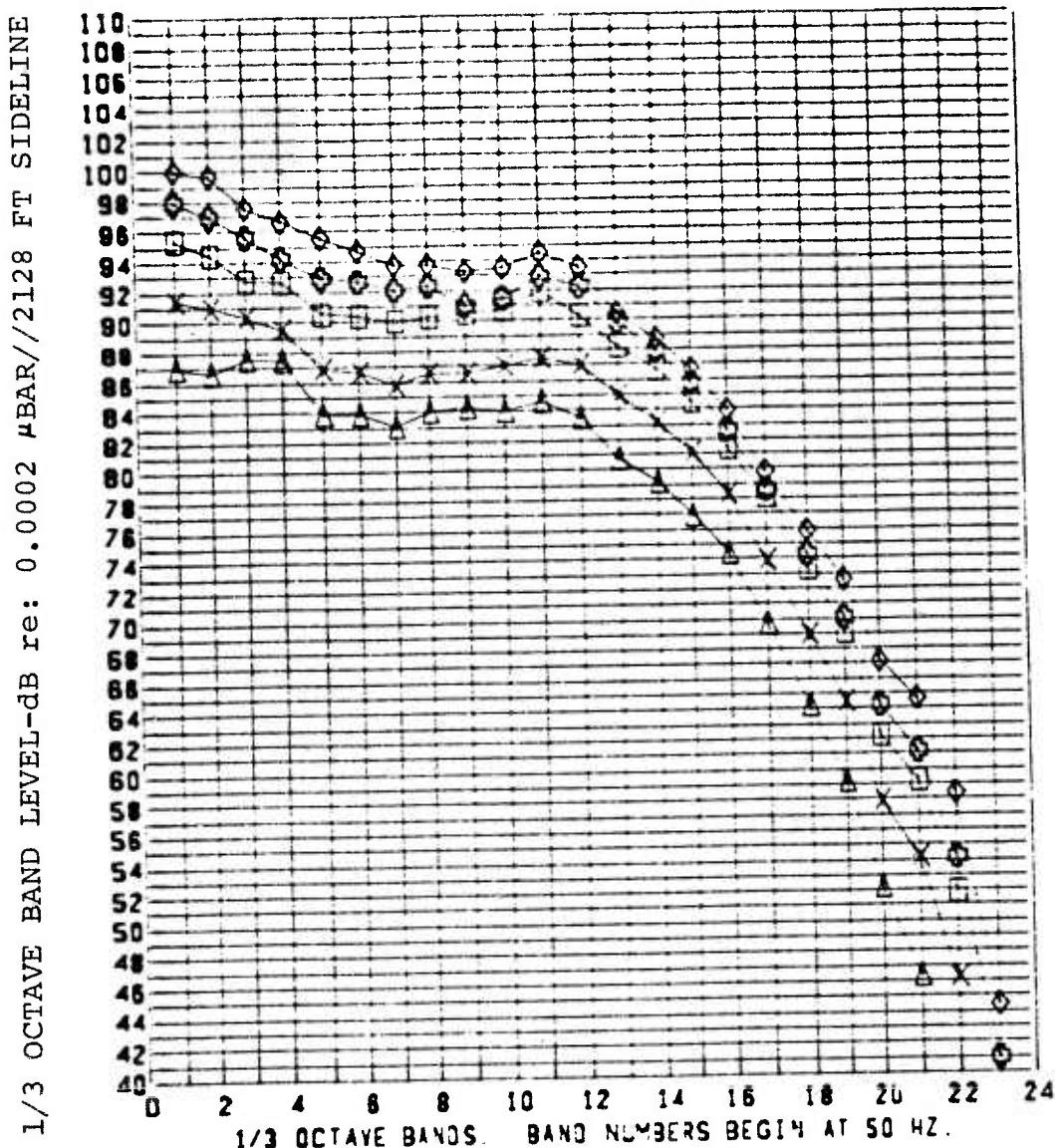
TT = 1150°F A8 = 6.05 FT² RUN: 008
 PR = △ 2.0, X 2.5, □ 3.0, + 3.5, ◆ 4.0

NOZZLE: 7T-3.3AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
 re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 008

PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.5, \diamond 4.0

NOZZLE: 7T-3.3AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°

re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 7T-3.3AR~CPA-ET/RC

FACILITY: WALL ISOLATION FACILITY

DATE: January 18, 1973

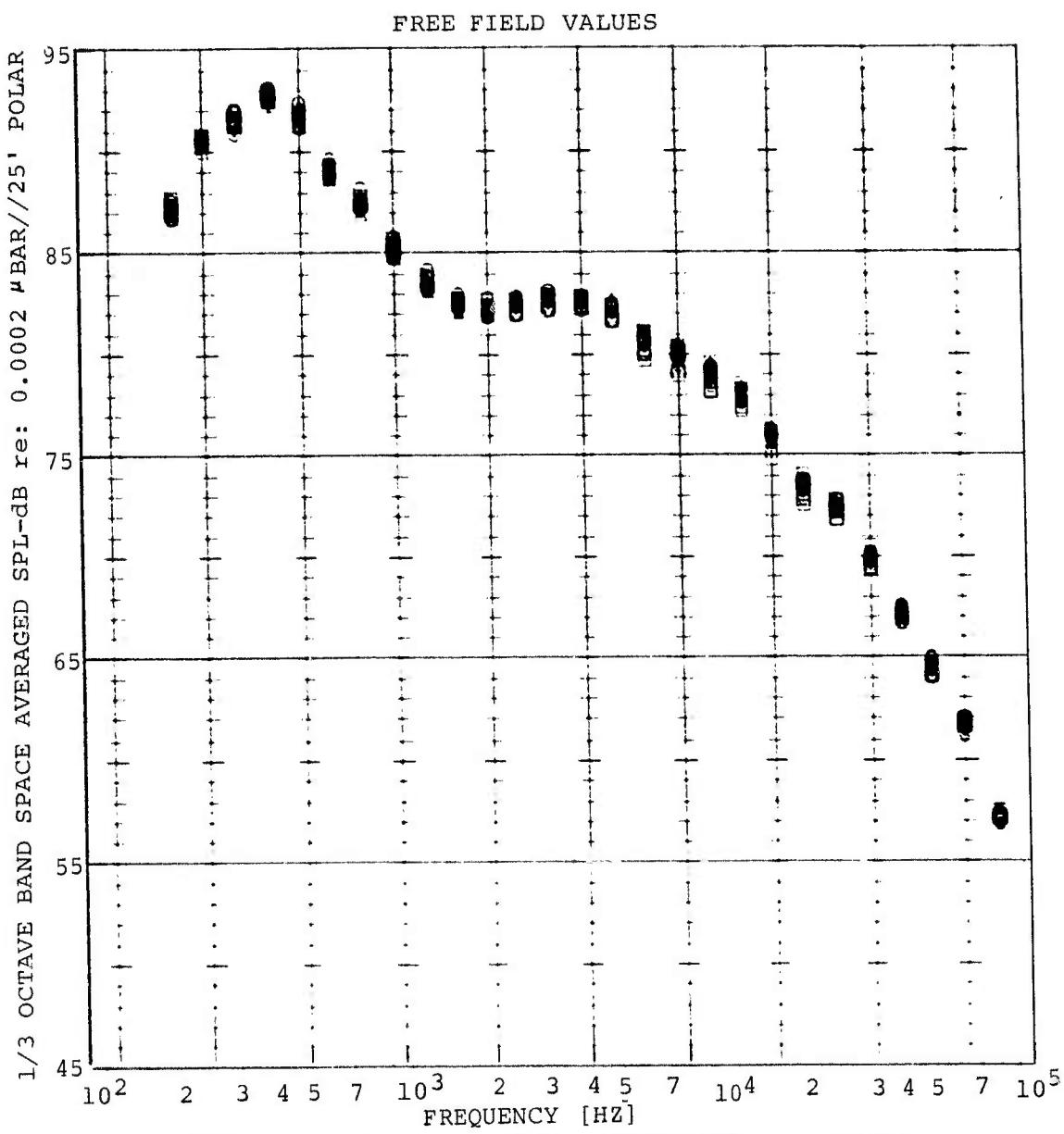
P_{AMB} = 29.43 in Hg **T_{AMB}** = 47°F **R.H.** = 66%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

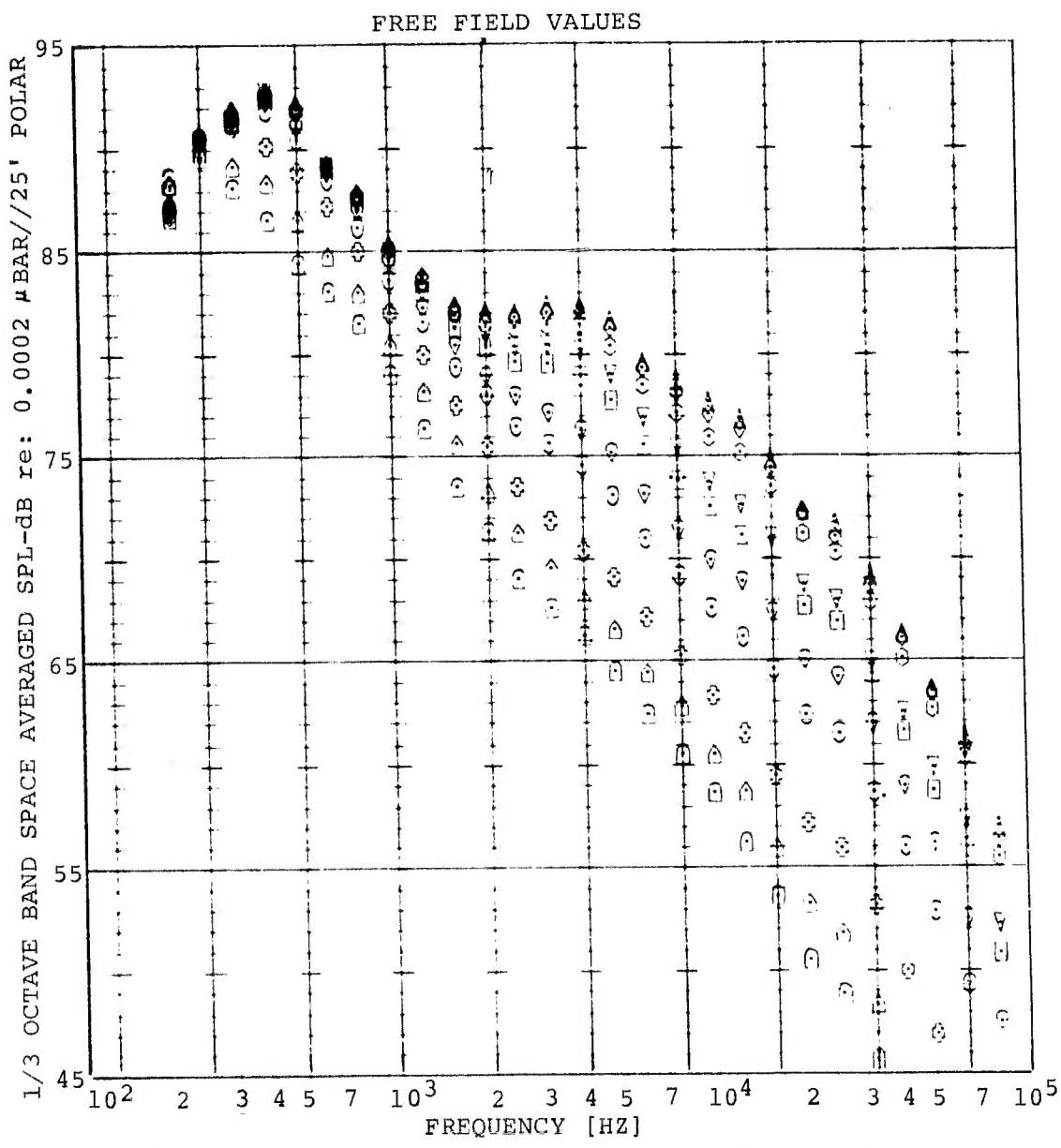
SCALE MODEL A₈ = 13.6 in.²

RUN NO.	AXIAL LOCATION	IRIS DIA.	REMARKS	REF.
75	0.0 x/D	9.0 in.		
76	0.25	9.0		
77	0.50	9.0		
78	0.75	9.0		
79	1.00	10.0		
80	1.25	10.0		
81	1.50	10.5		
82	1.75	10.5		
83	2.00	11.0		
84	2.25	11.0		
85	2.50	11.5		
86	2.75	11.5		
87	3.0	12.0		
88	3.5	13.0		
89	4.0	14.0		
90	5.0	16.0		
91	6.0	18.0		
92	8.0	19.0		
93	10.0	21.0		
94	12.0	23.0		
95	14.0	25.0		
96	16.0	27.0		

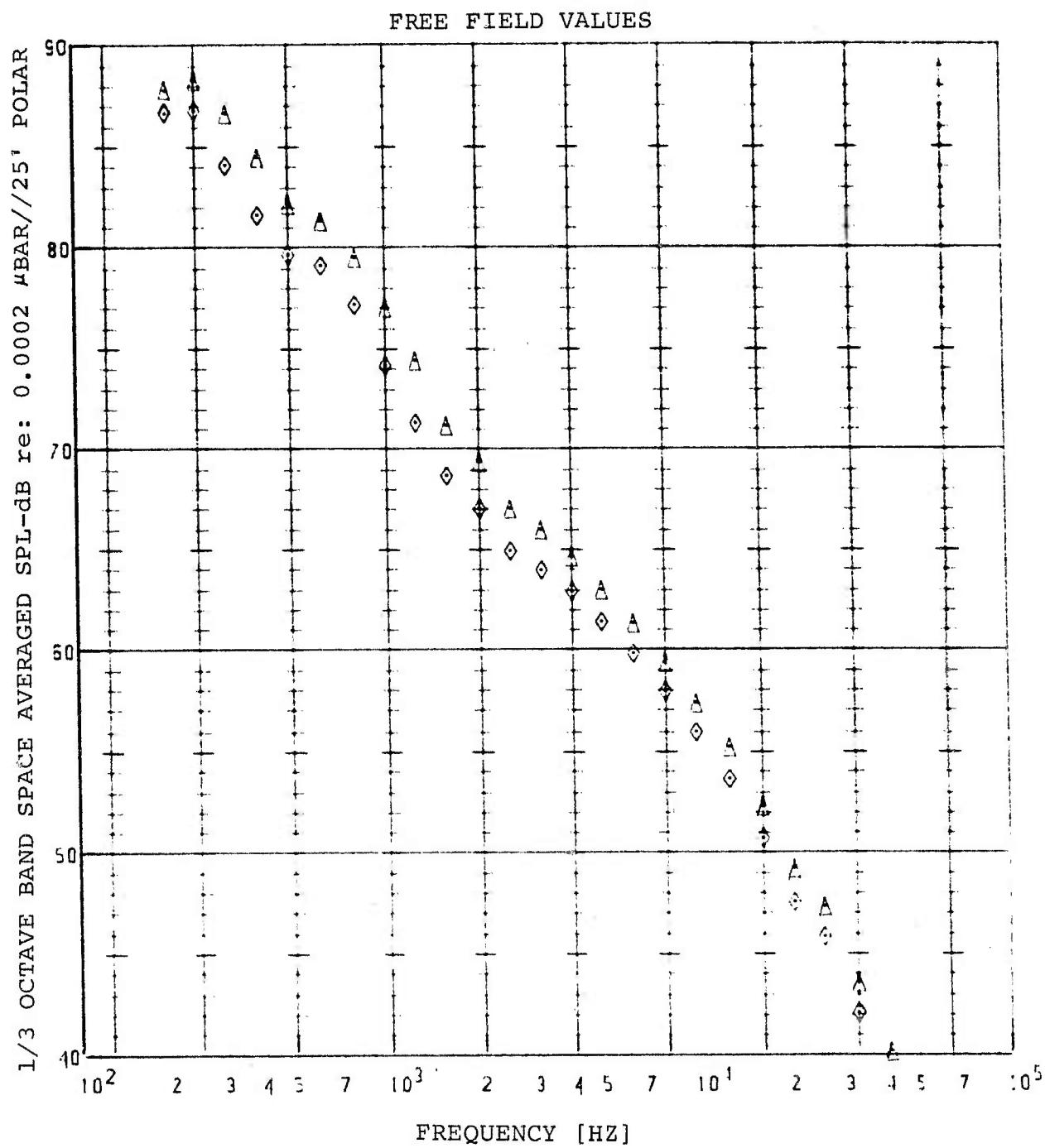
MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC



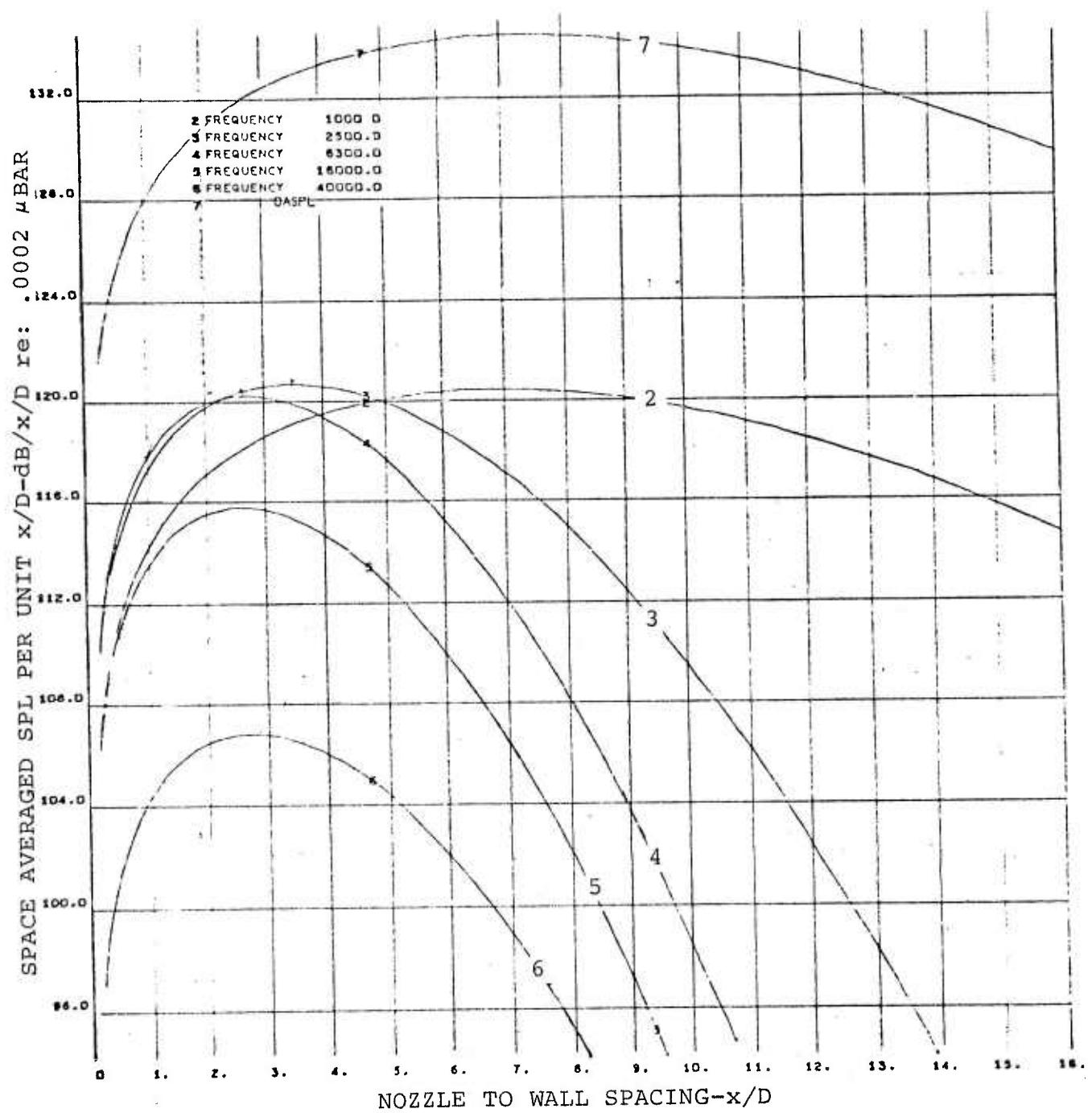
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	75	1150°F	3.000	0.0
◆	76	1150	3.000	.25
○	77	1150	3.000	.50
▽	78	1150	3.000	.75
□	79	1150	3.000	1.0
▼	80	1150	3.000	1.25
○	81	1150	3.000	1.5
✚	82	1150	3.000	1.75
△	83	1150	3.000	2.0
□	84	1150	3.000	2.25

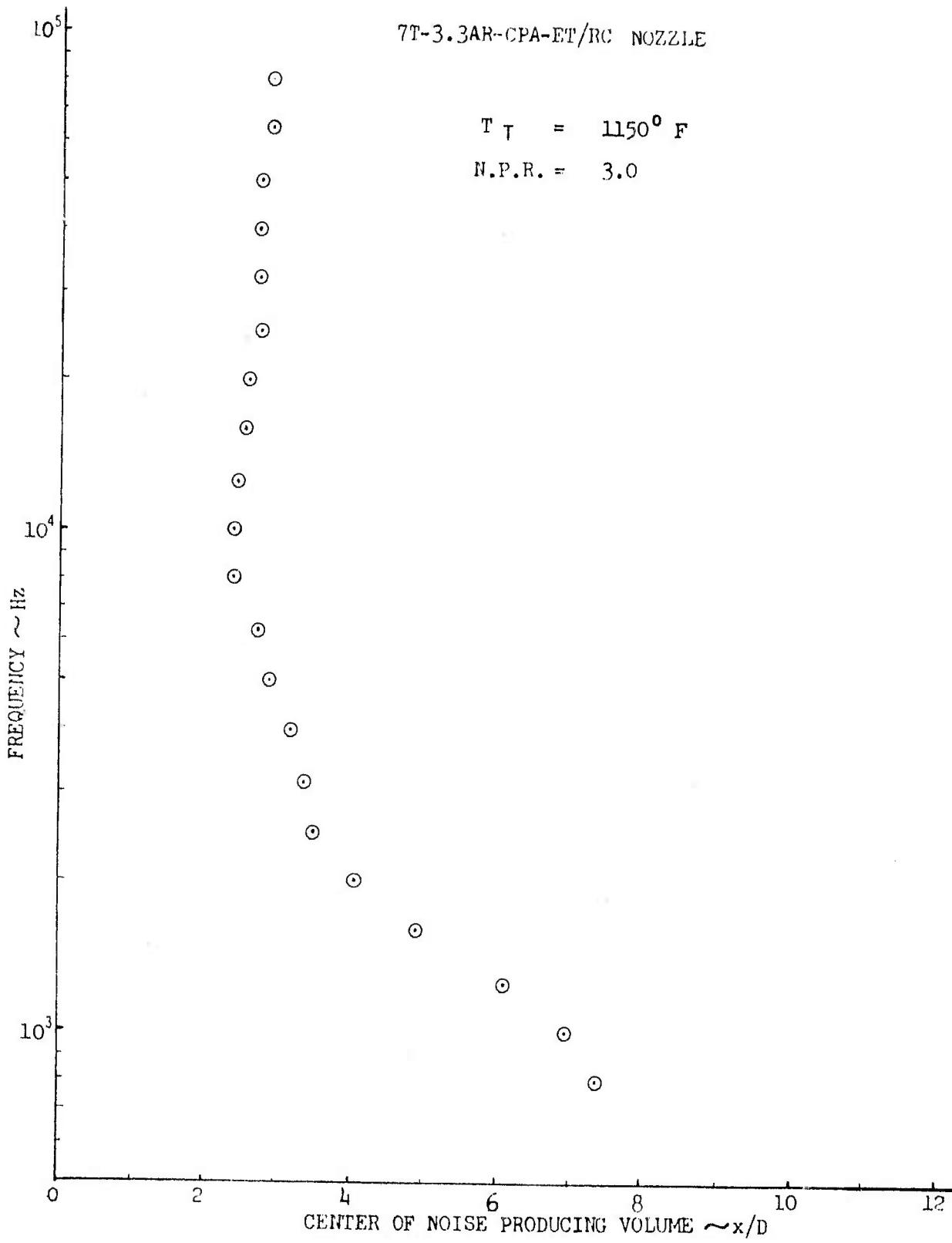


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	85	1150°F	3.000	2.5
◊	86	1150	3.000	2.75
○	87	1150	3.000	3.0
▽	88	1150	3.000	3.50
□	89	1150	3.000	4.00
□	90	1150	3.000	5.00
○	91	1150	3.000	6.00
□	92	1150	3.000	8.00
□	93	1150	3.000	10.00
□	94	1150	3.000	12.00



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	95	1150°F	3.0	14.00
◊	96	1150	3.0	16.00



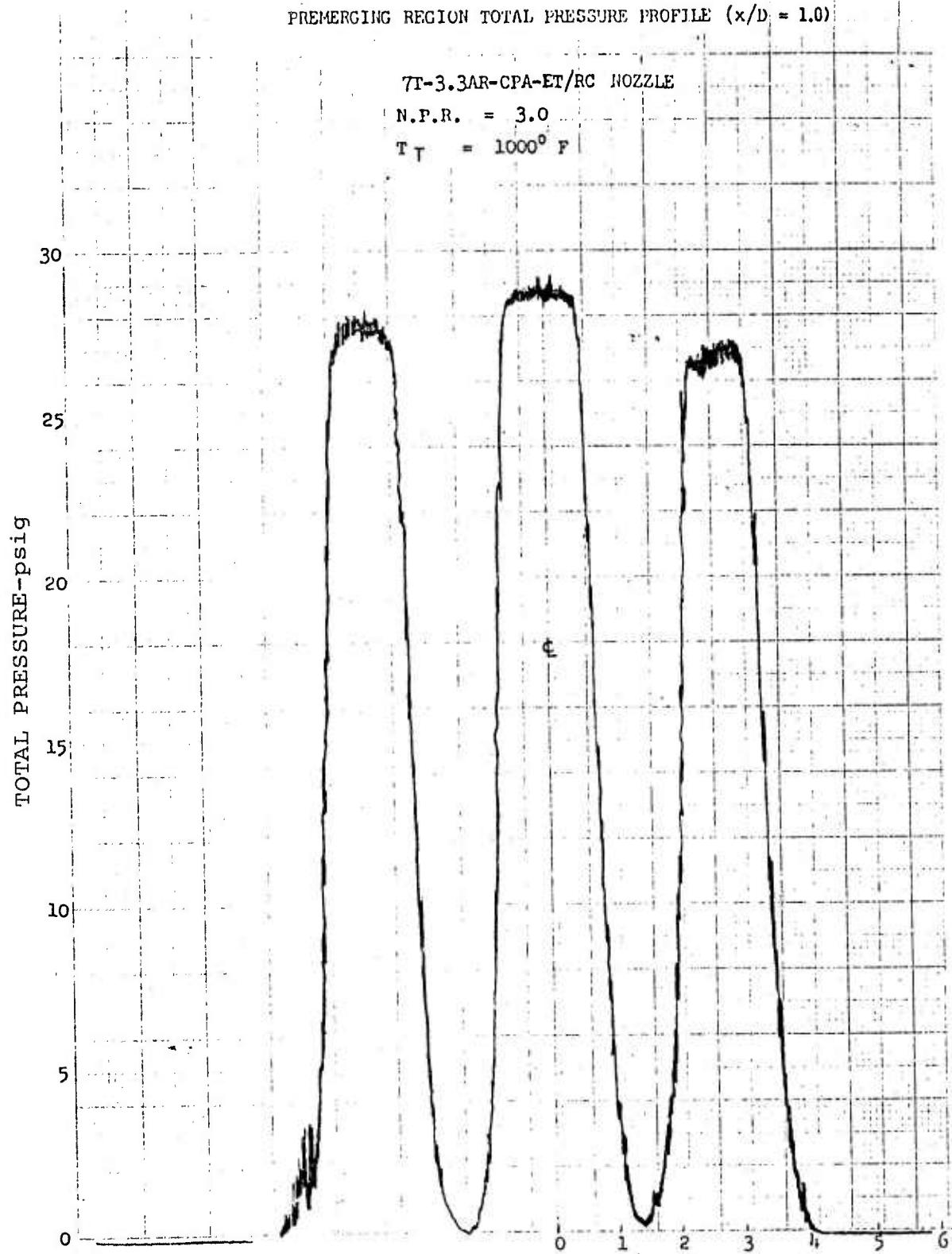


PREMERGING REGION TOTAL PRESSURE PROFILE ($x/D = 1.0$)

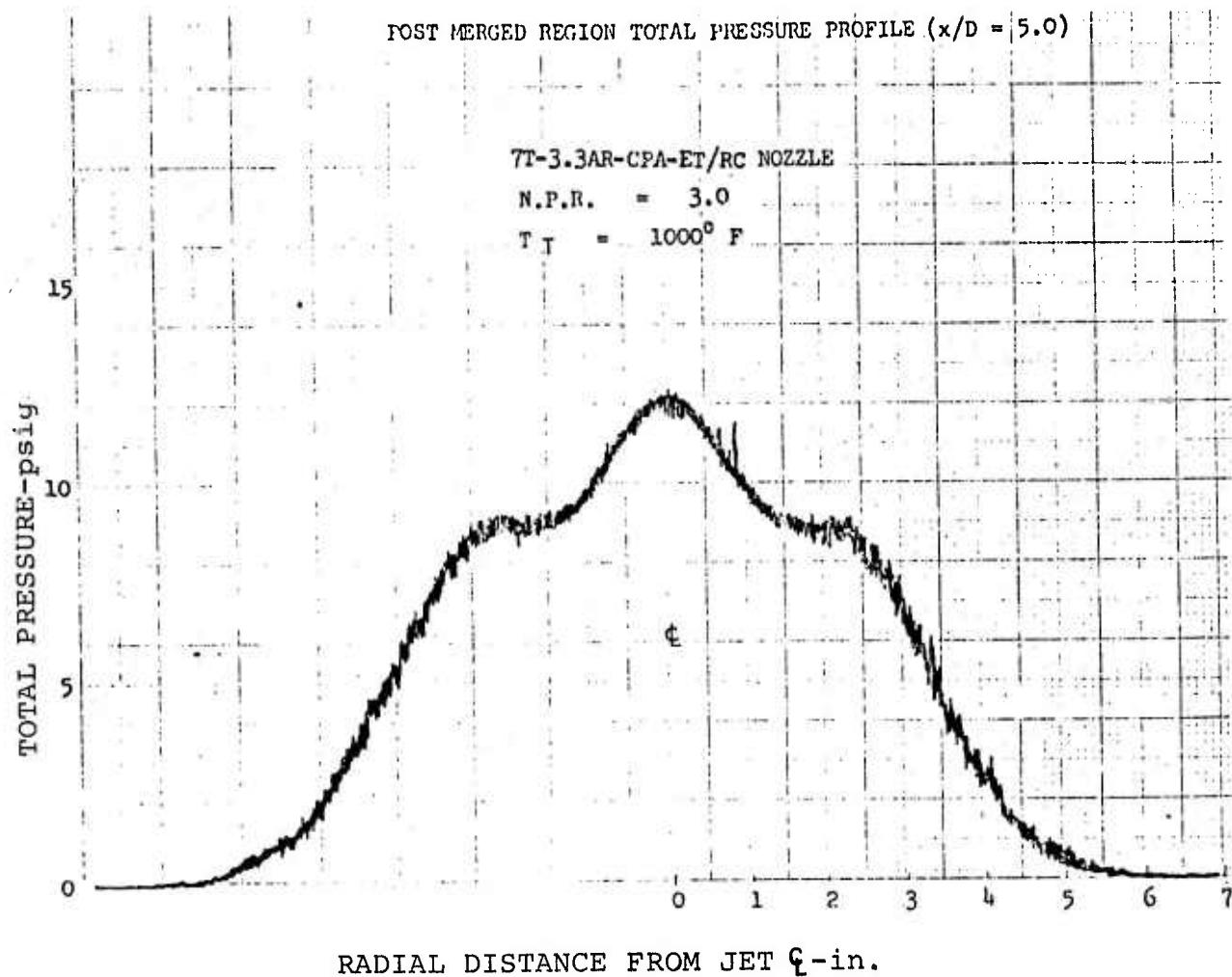
7T-3.3AR-CPA-ET/RC NOZZLE

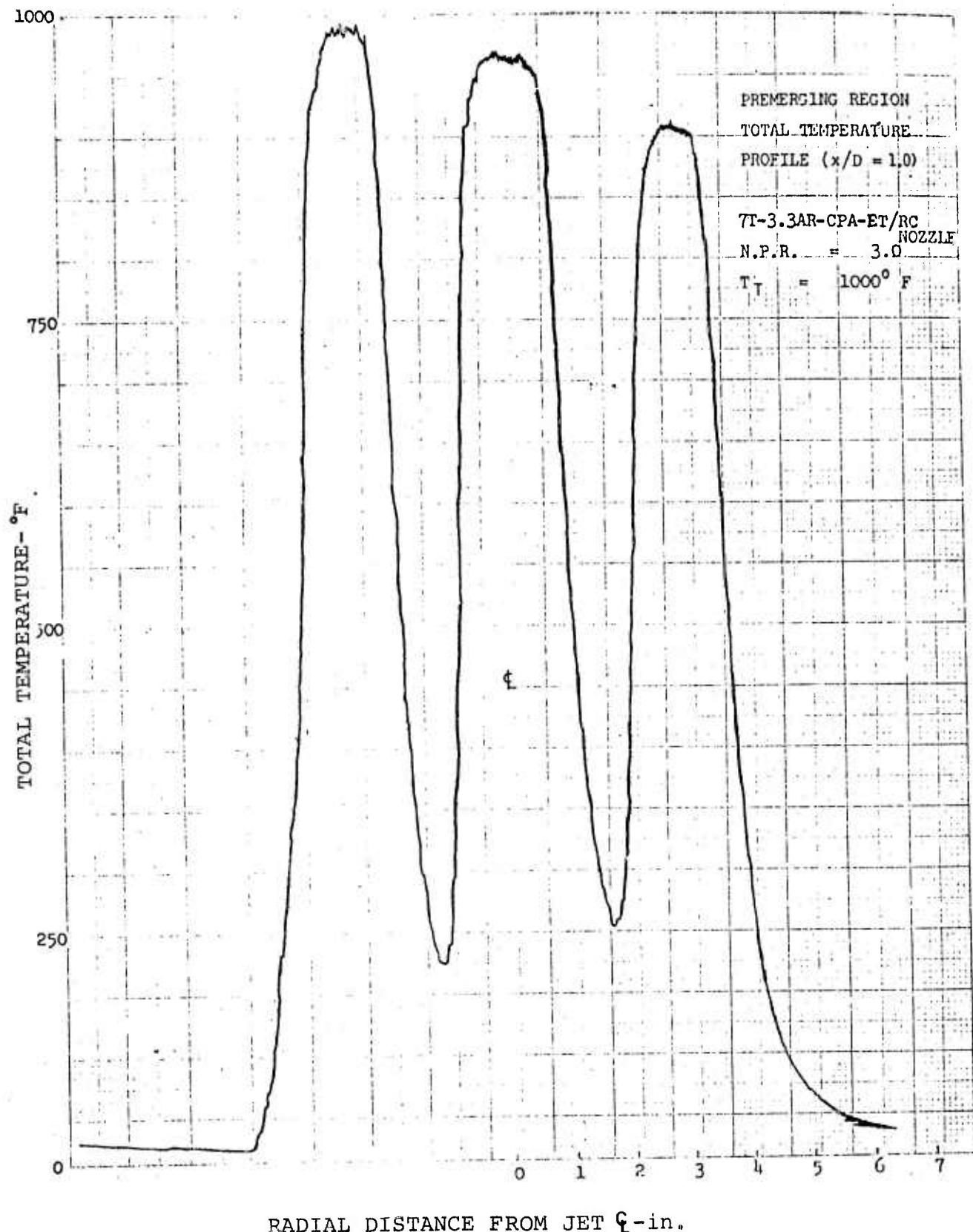
N.P.R. = 3.0

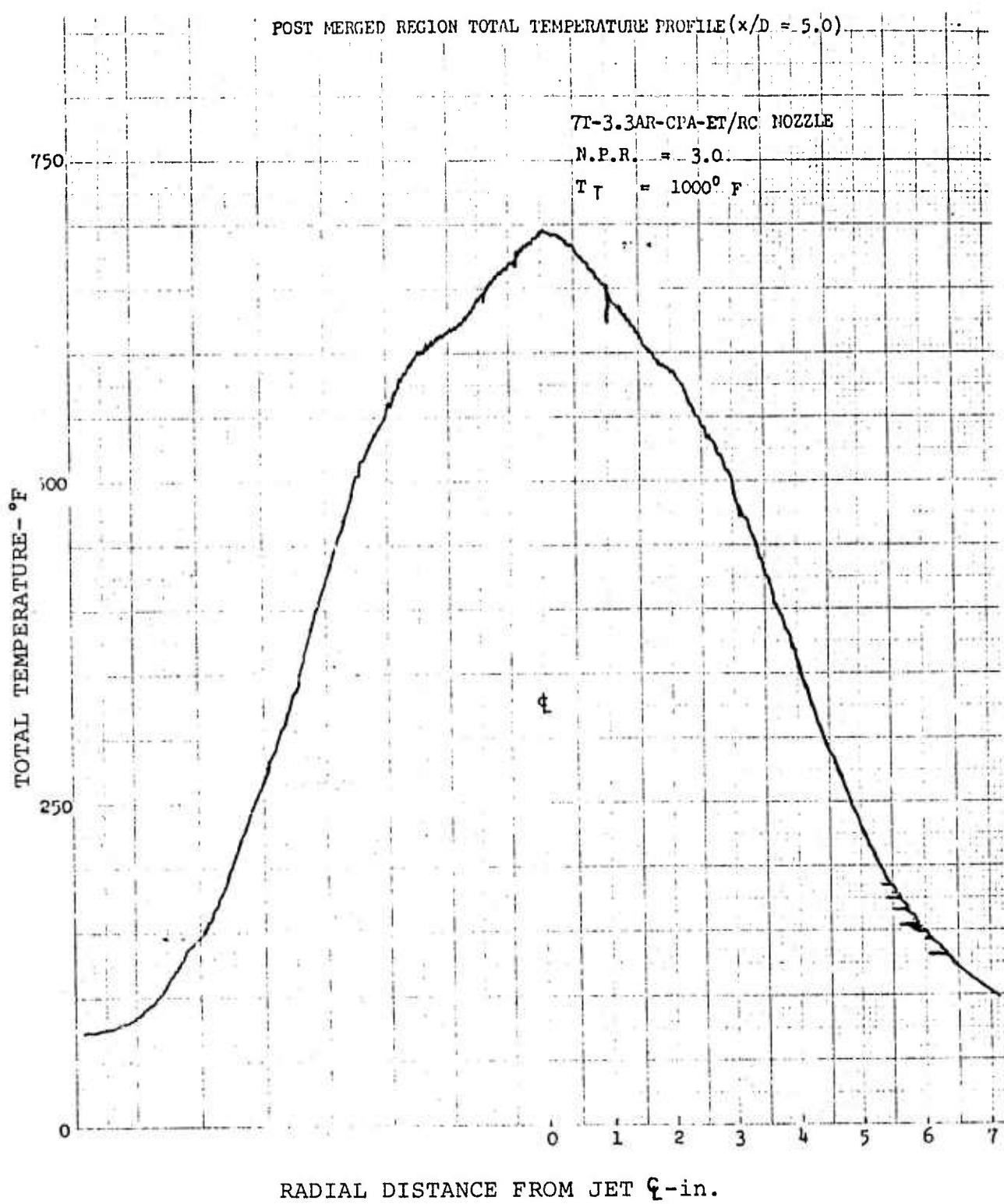
$T_T = 1000^{\circ} F$

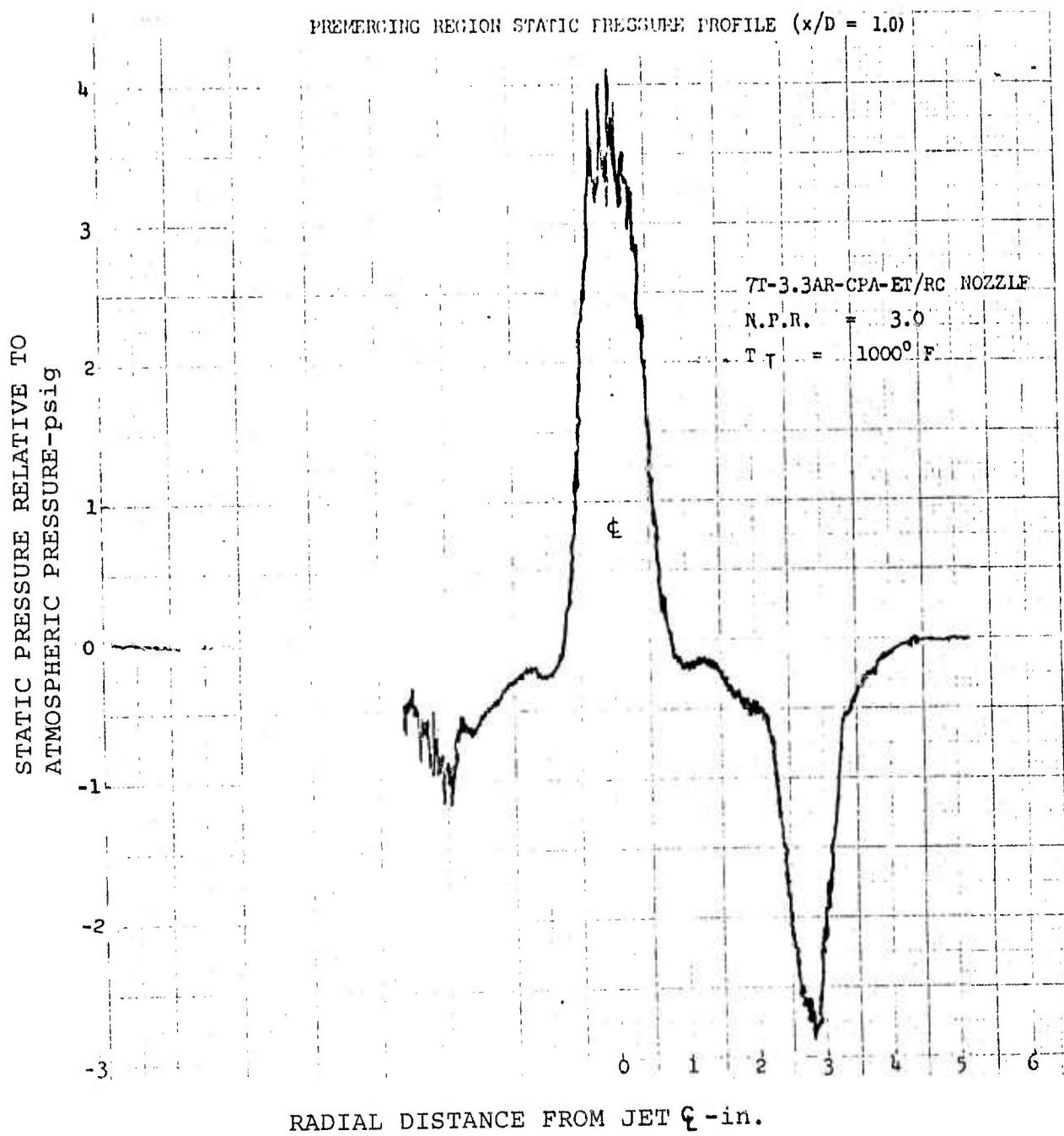


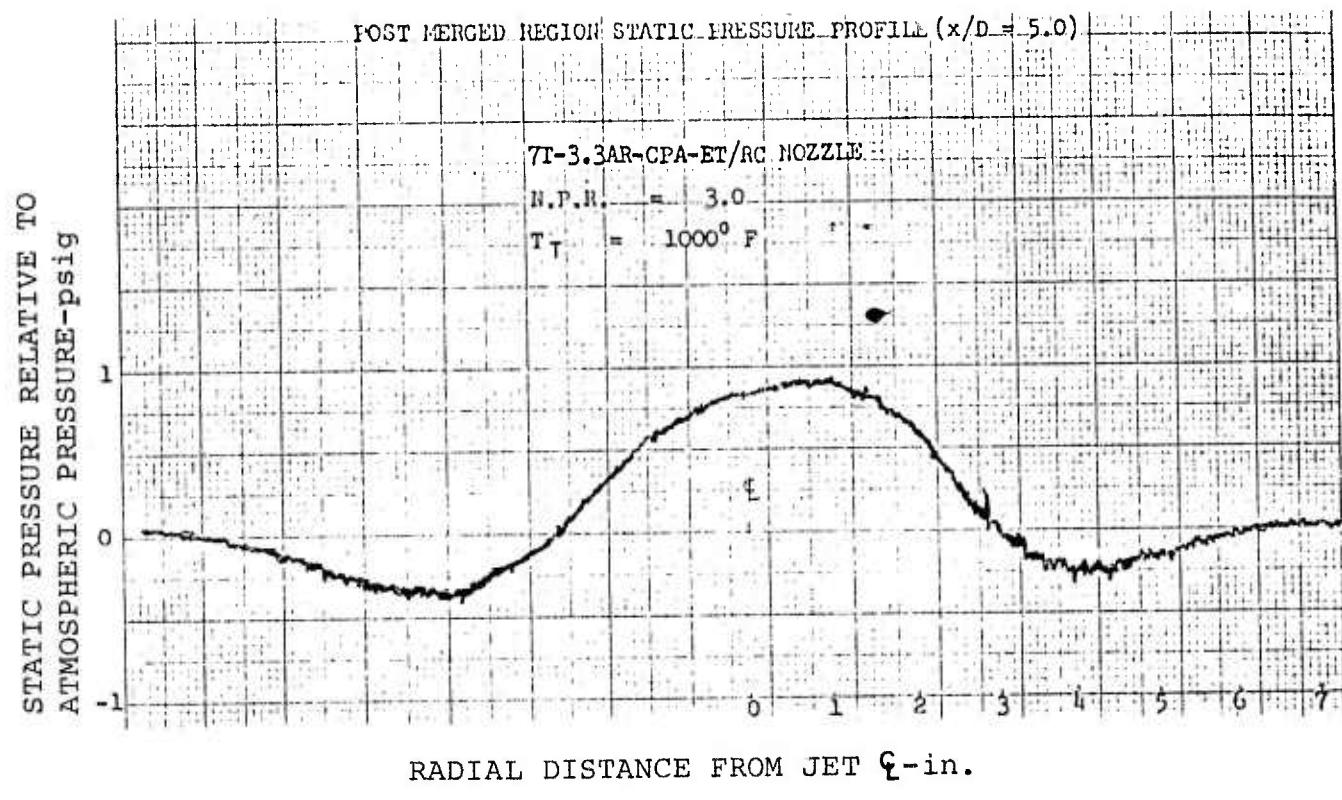
RADIAL DISTANCE FROM JET ζ -in.

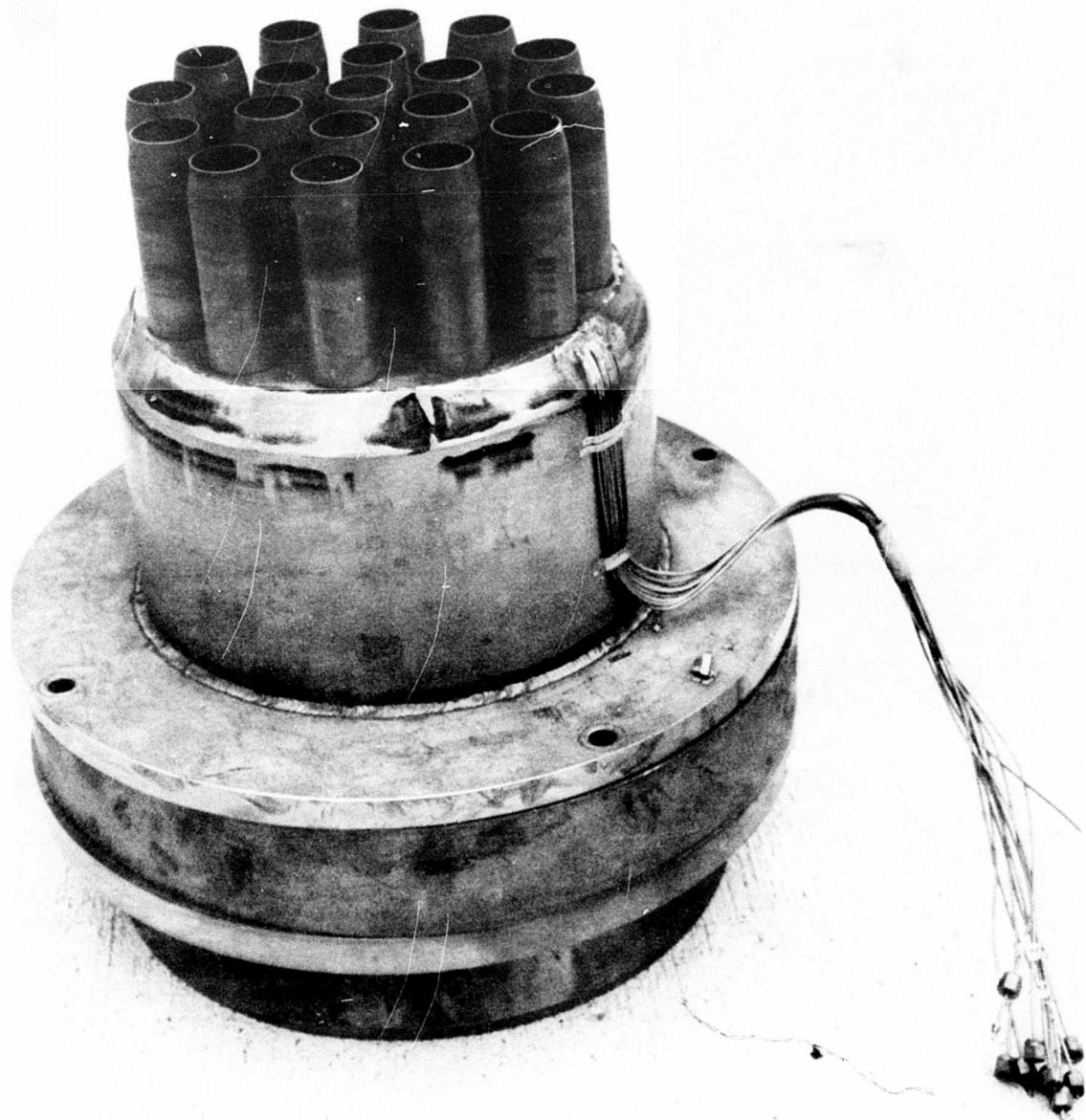




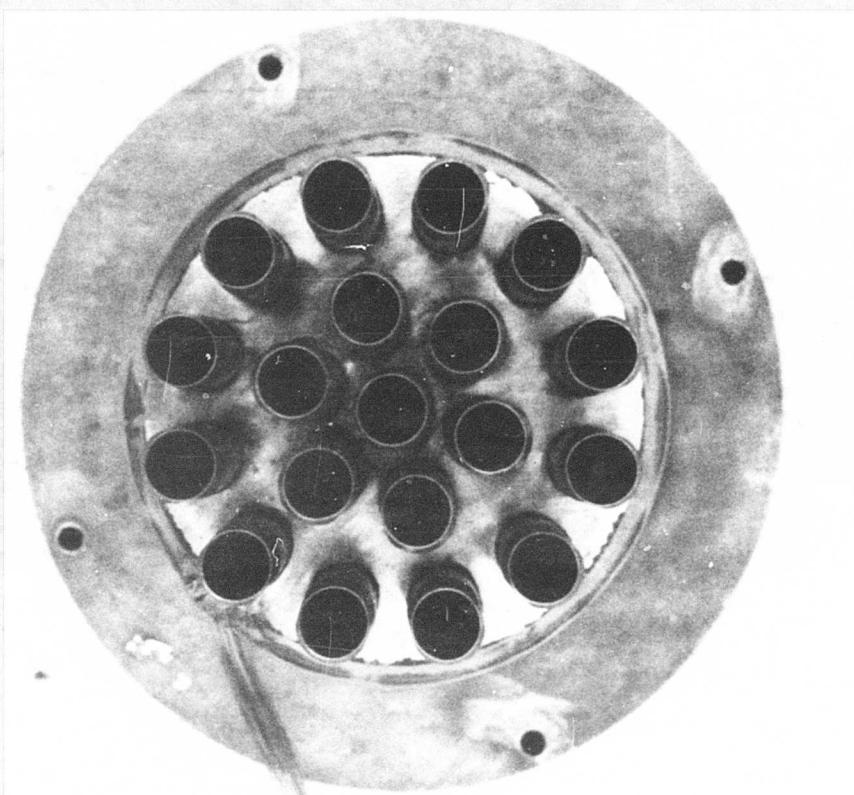




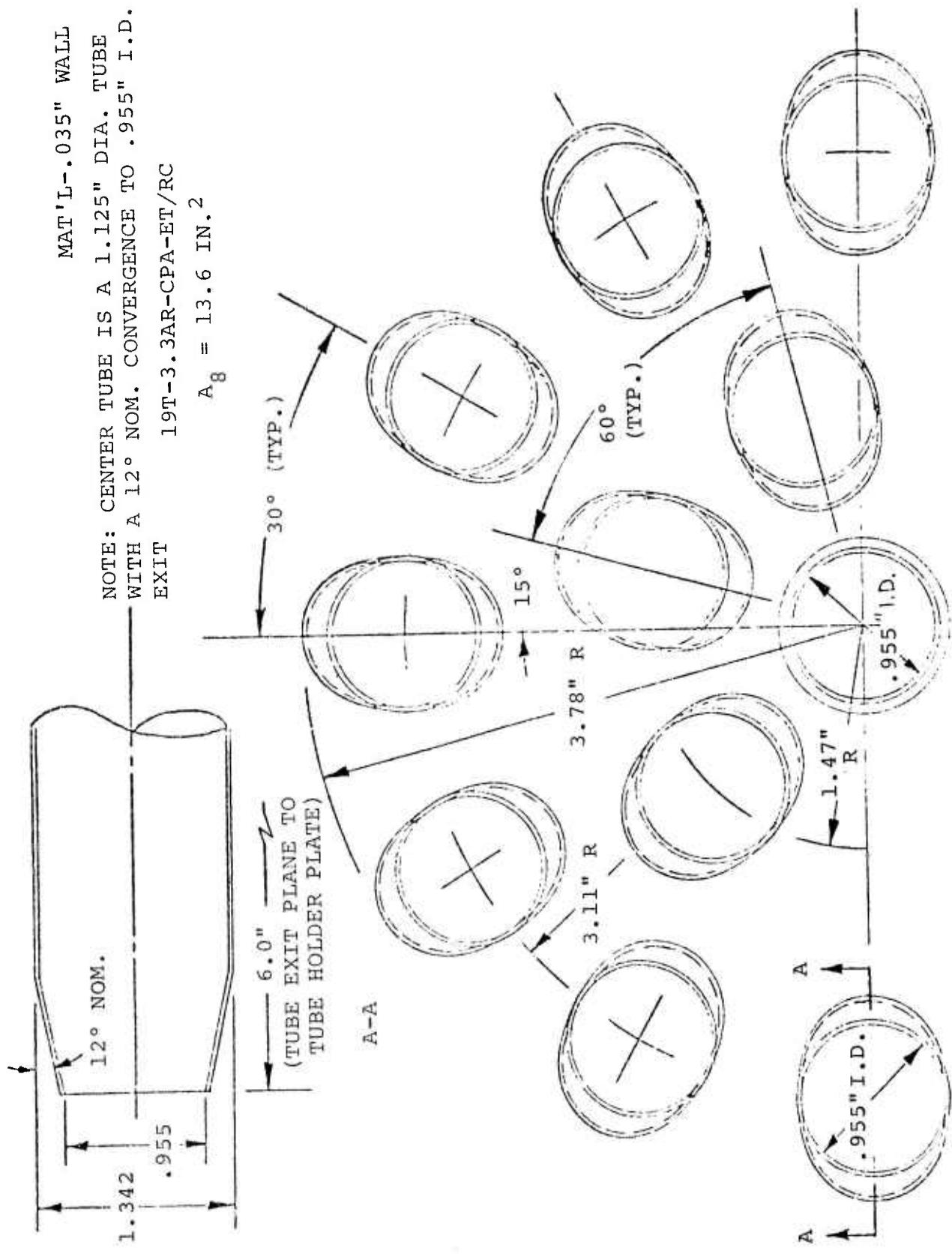




19T-3.3AR-CPA-ET/RC NOZZLE



19T-3.3AR-CPA-ET/RC NOZZLE



19 TUBE - AREA RATIO 3.3 ELLIPTICAL TUBES CLOSE ARRAY

TEST CONDITIONS

NOZZLE: 19T-3.3AR-CPA-ET/RC

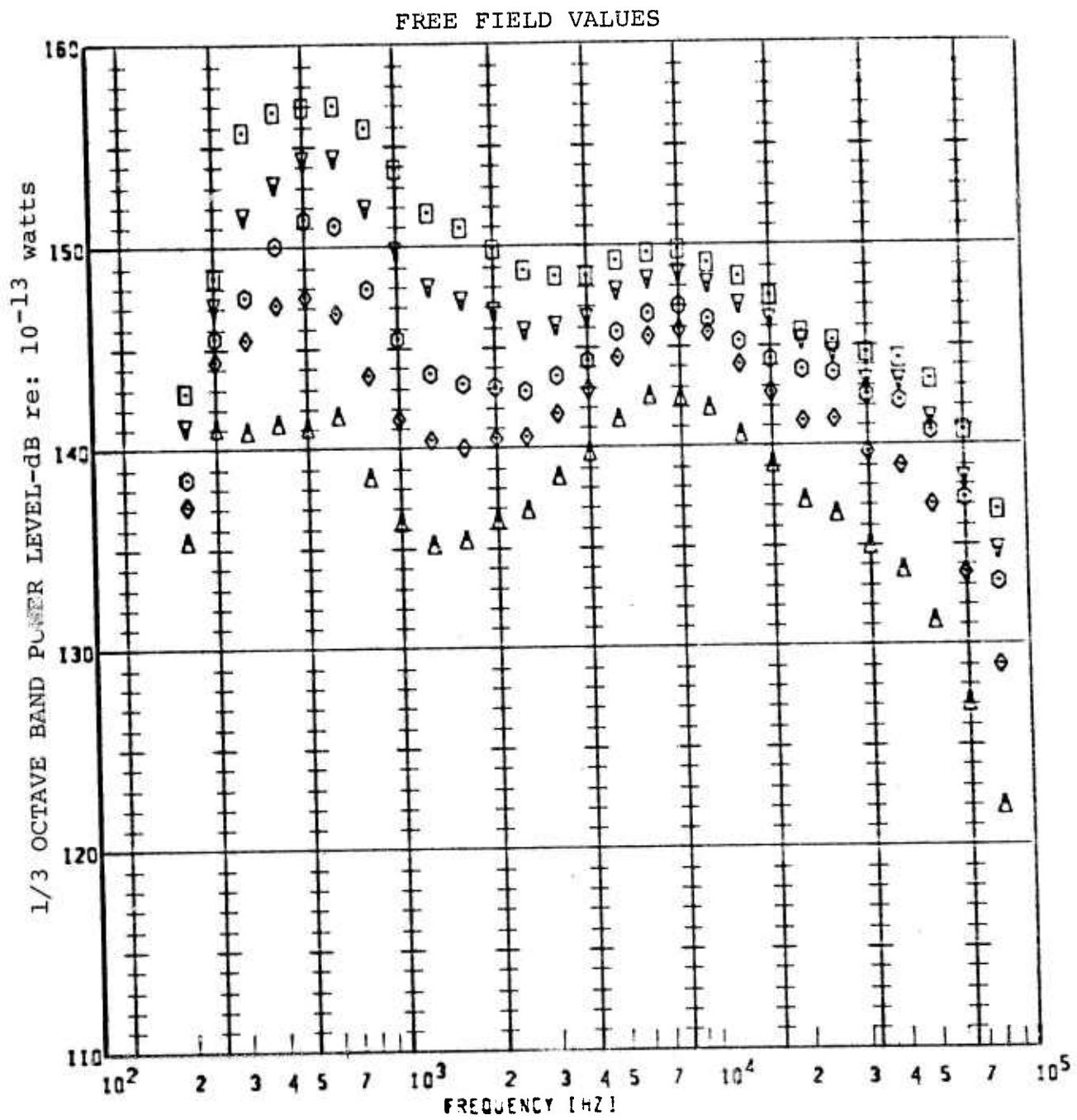
FACILITY: HNTF

DATE: 6-11-73 **T_{AMB}** = 77°F **R.H.** = 24%

SCALE MODEL A₈ = 13.6 in.²

RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
9	2.0	1150°F	1875 fps	6" tube lengths	
"	2.5	"	2126		
"	3.0	"	2303		
"	3.5	"	2437		
"	4.0	"	2544		

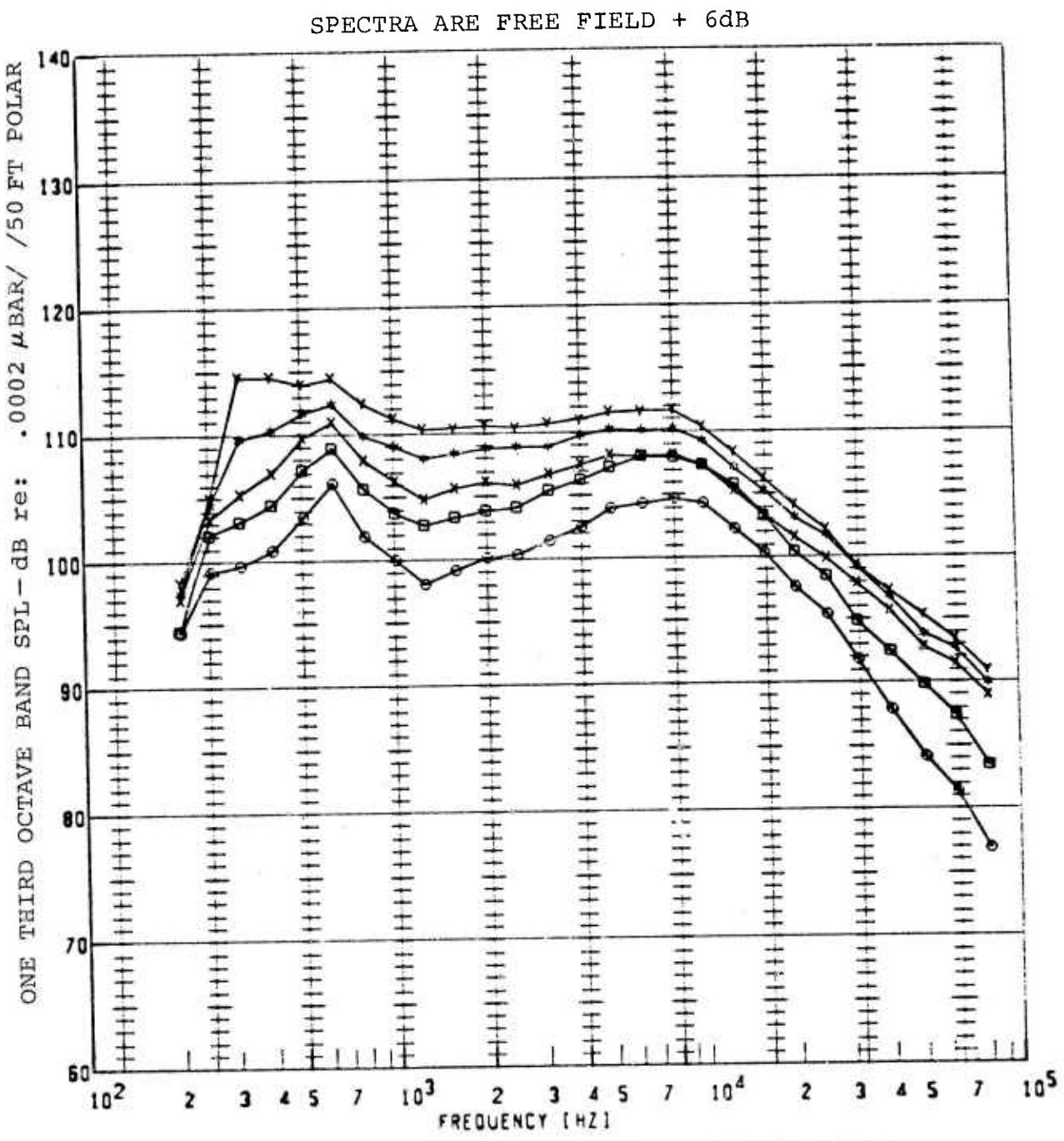
MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	009	2.00	1150°F
◊	009	2.50	1150
○	009	3.00	1150
▽	009	3.50	1150
□	009	4.00	1150

$A_8 = 13.6 \text{ IN.}^2$
NOZZLE: 19T-3.3AR-CPA-ET/RC

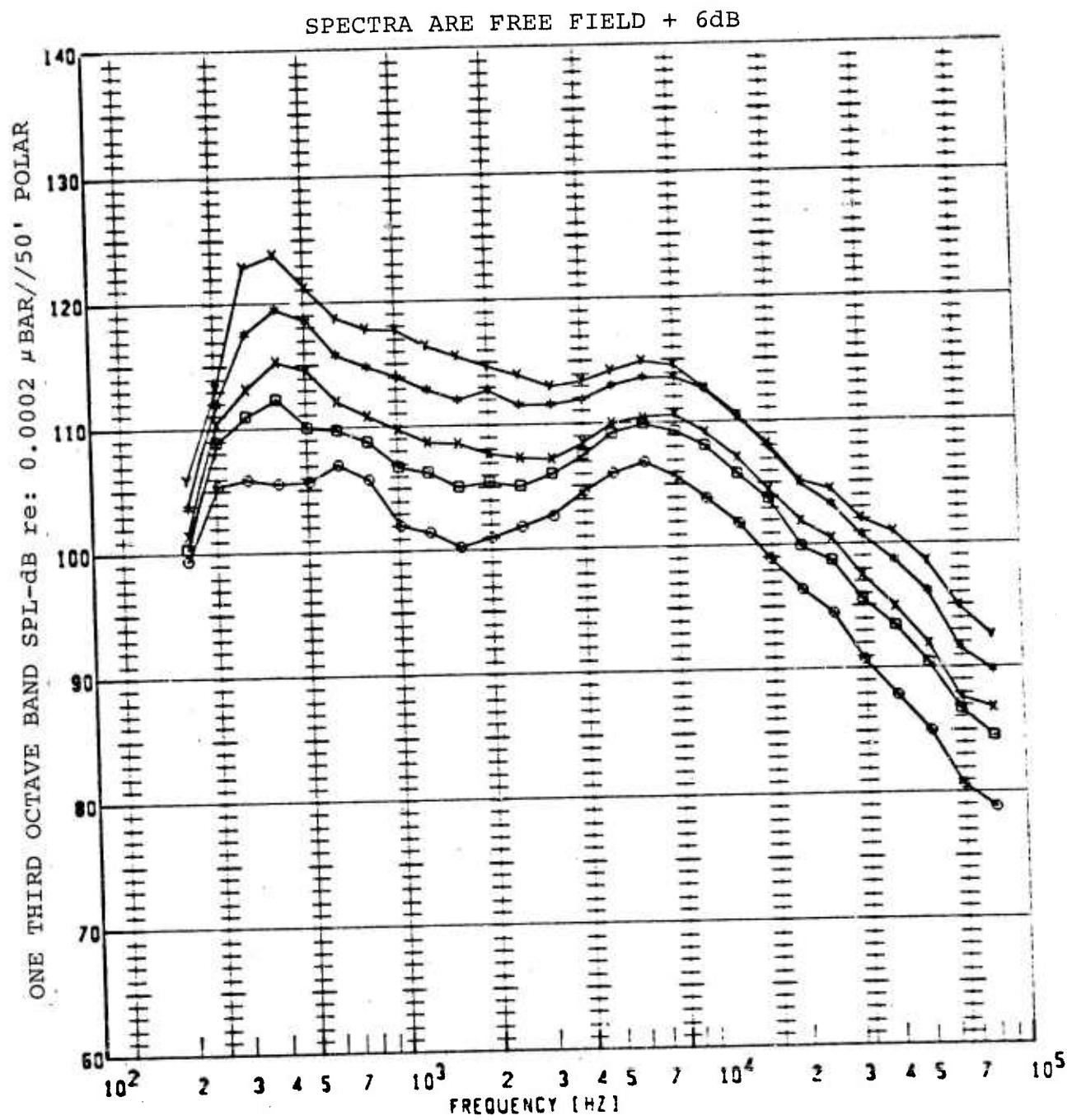
JET NOISE POWER SPECTRA



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [dB]
○	009G	1150°F	2.000	110	50FP	115.3
□	009G	1150	2.500		50FP	118.7
×	009G	1150	3.000		50FP	120.1
*	009G	1150	3.500		50FP	122.4
◊	009G	1150	4.000		50FP	124.5

NOZZLE: 19T-3.3AR-CPA-ET-/RC

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

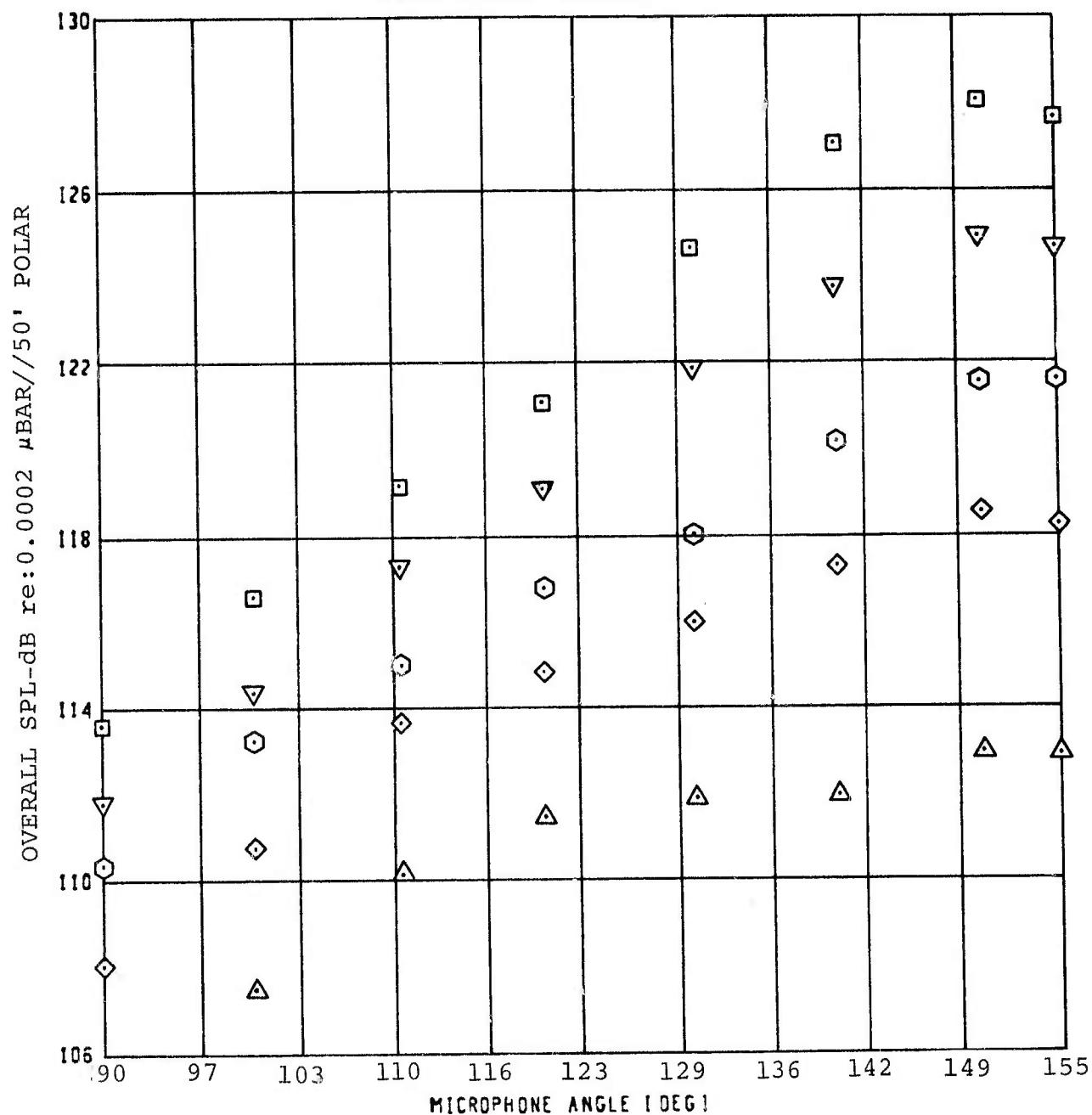


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	GAS ²
o	009G	1150°F	2.000	130°	SCFP	117.3
o	009G	1150	2.500		SCFP	121.3
x	009G	1150	3.000		SCFP	123.5
*	009G	1150	3.500		SCFP	127.3
y	009G	1150	4.000		SCFP	130.4

NOZZLE: 19T-3.3AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS

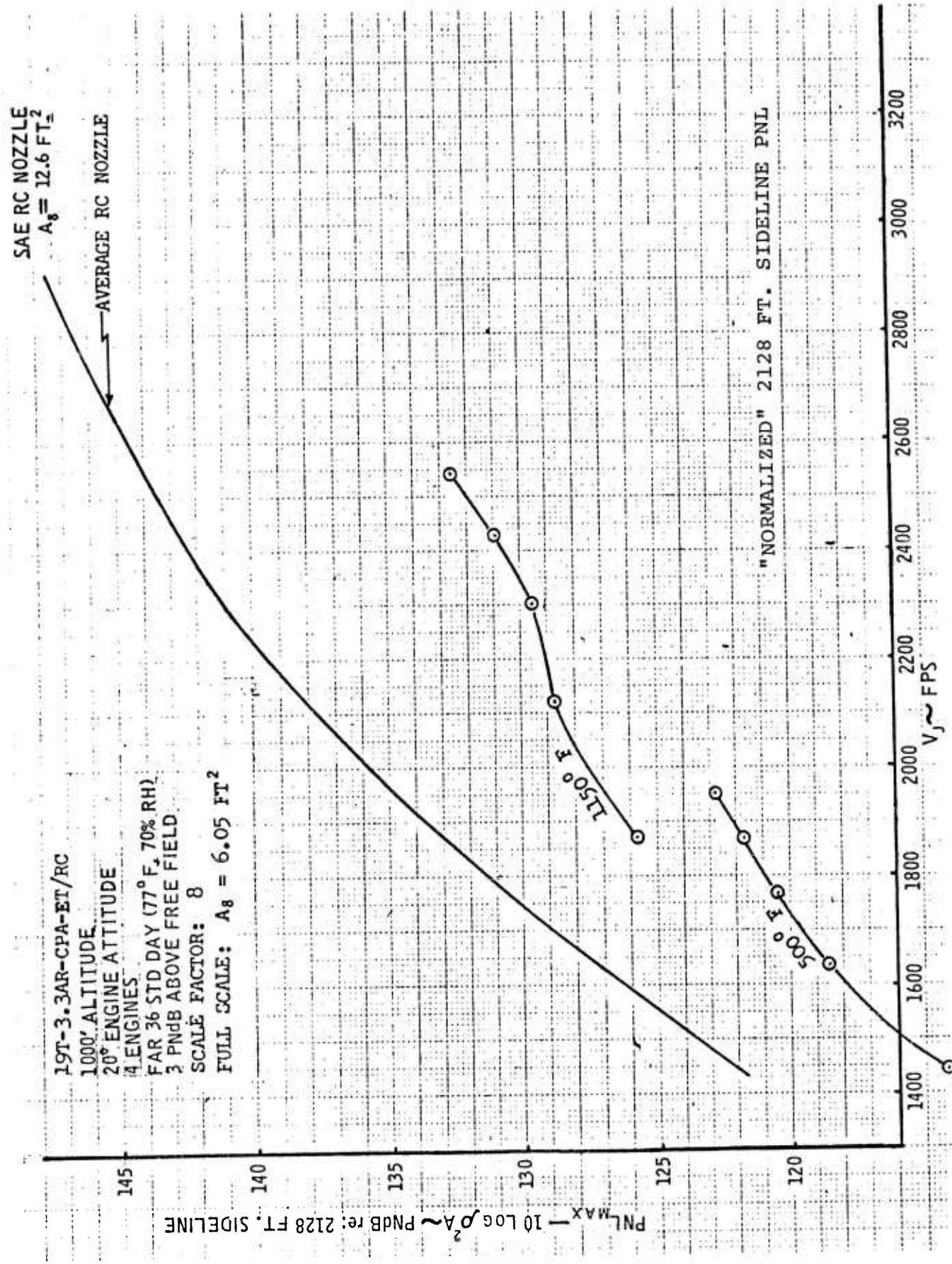
FREE FIELD VALUES

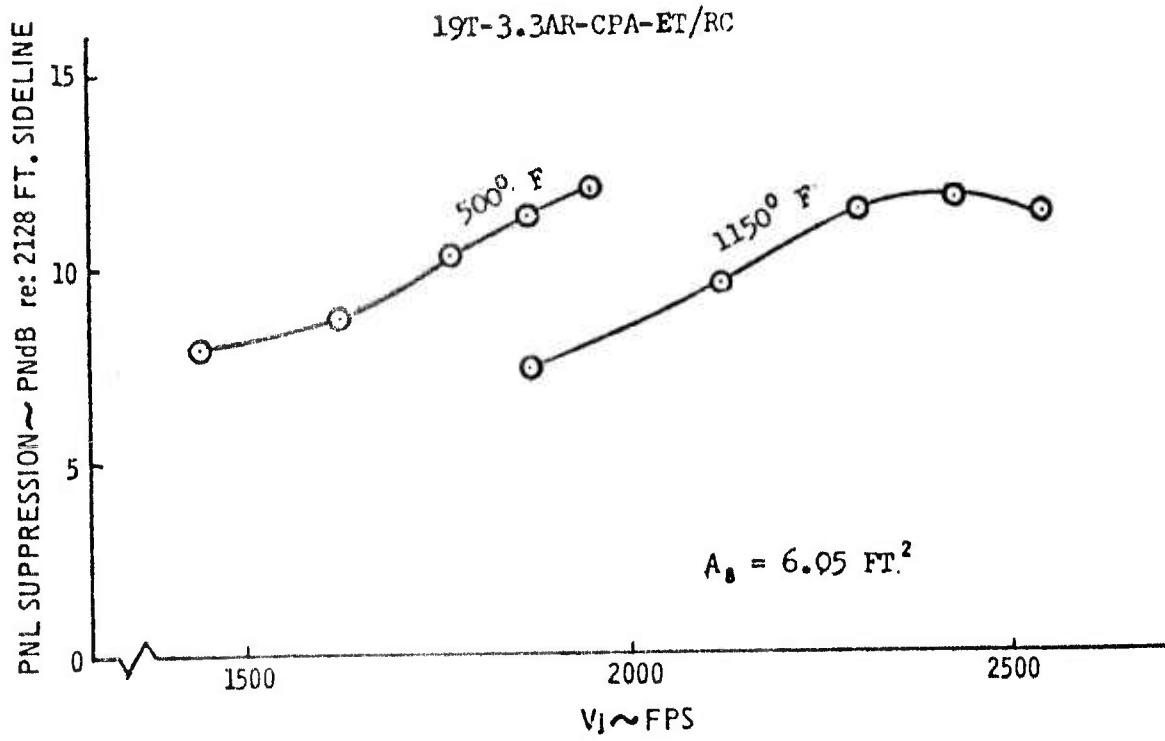


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	009	2.00	1150°F
◊	009	2.50	1150
○	009	3.00	1150
▽	009	3.50	1150
□	009	4.00	1150

NOZZLE: 19T-3.3AR-CPA-ET/RC

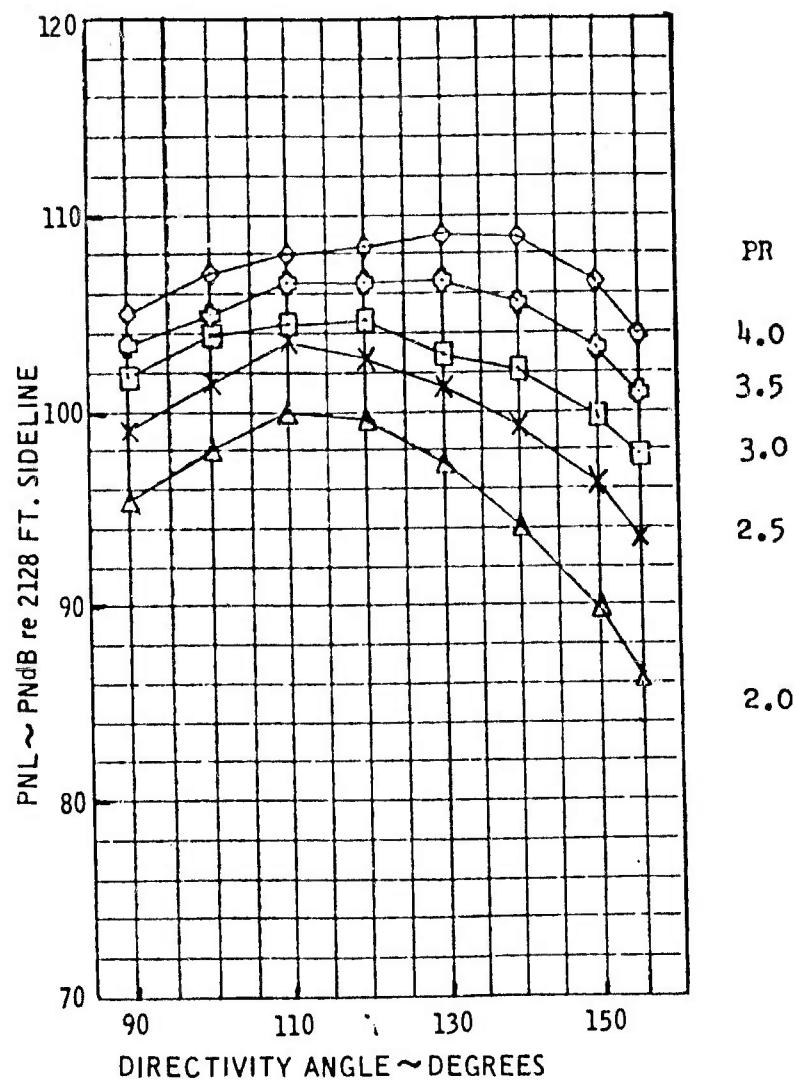
OASPL BEAM PATTERNS





PEAK PNL SUPPRESSION VALUES

NOZZLE: 19T-3.3AR-CPA-~~RT~~/RC



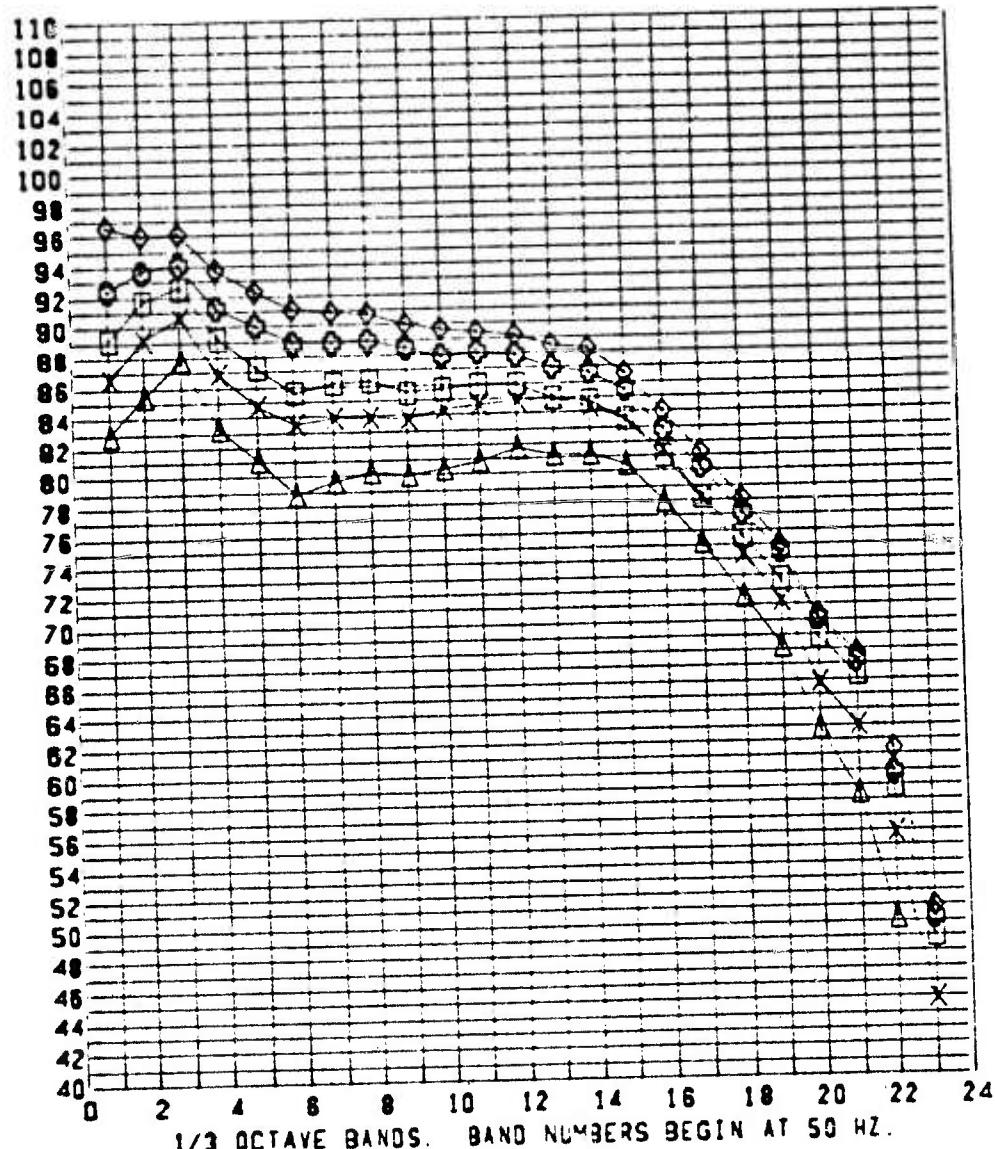
RUN 009
TT = 1150° F · A8 = 6.05 FT²

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT

1/3 OCTAVE BAND LEVEL-dB re: 0.0002 μ BAR//2128 FT SIDELINE



TT = 1150°F A8 = 6.05 FT² RUN: 009

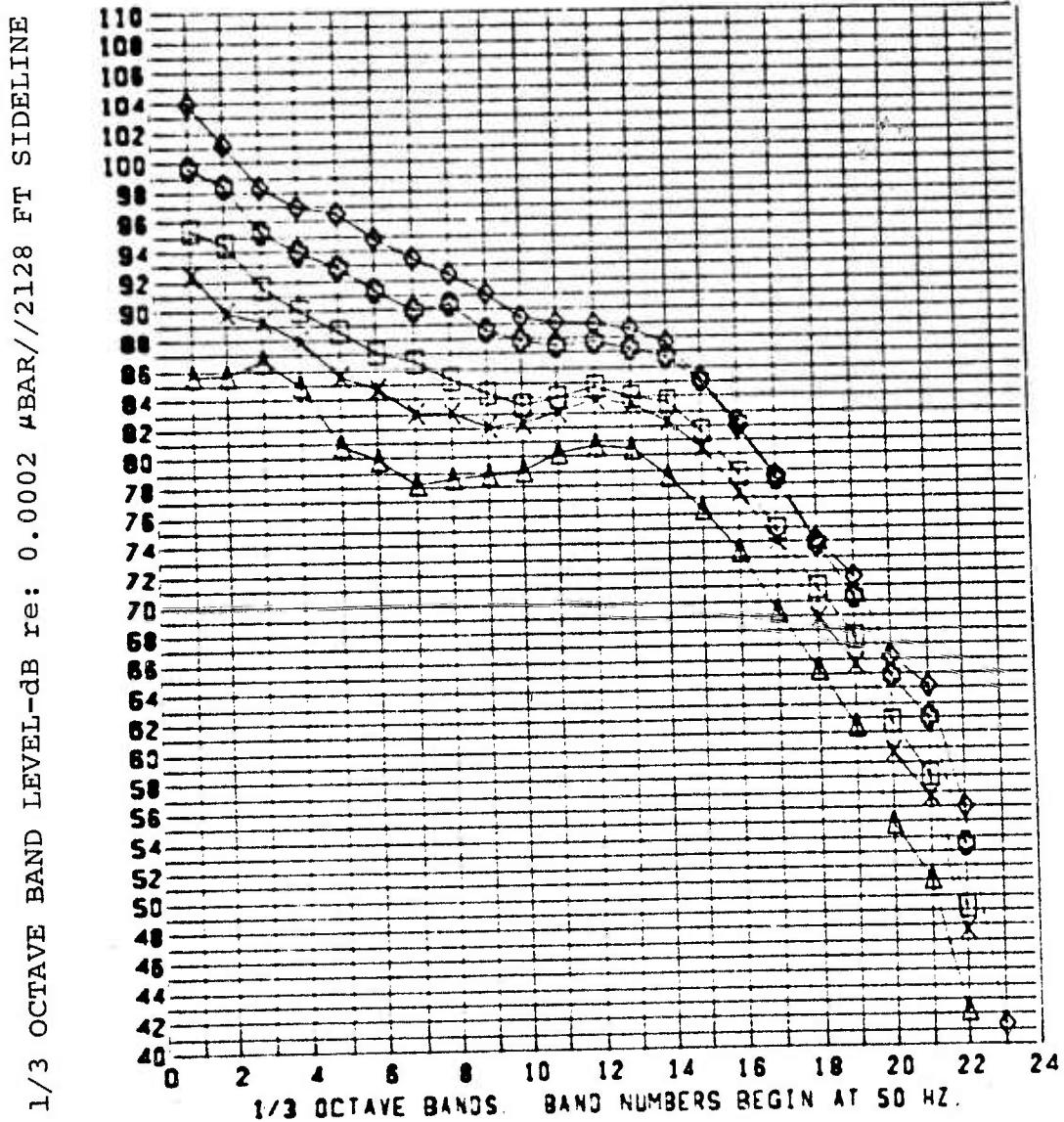
PR = Δ 2.0, X 2.5, □ 3.0, + 3.5, ◇ 4.0

NOZZLE: 19T-3.3AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



NOZZLE: 19T-3.3AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°
re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 19T-3.3AR-CPA-ET/RC

FACILITY: WALL ISOLATION FACILITY

DATE: January 19, 1973

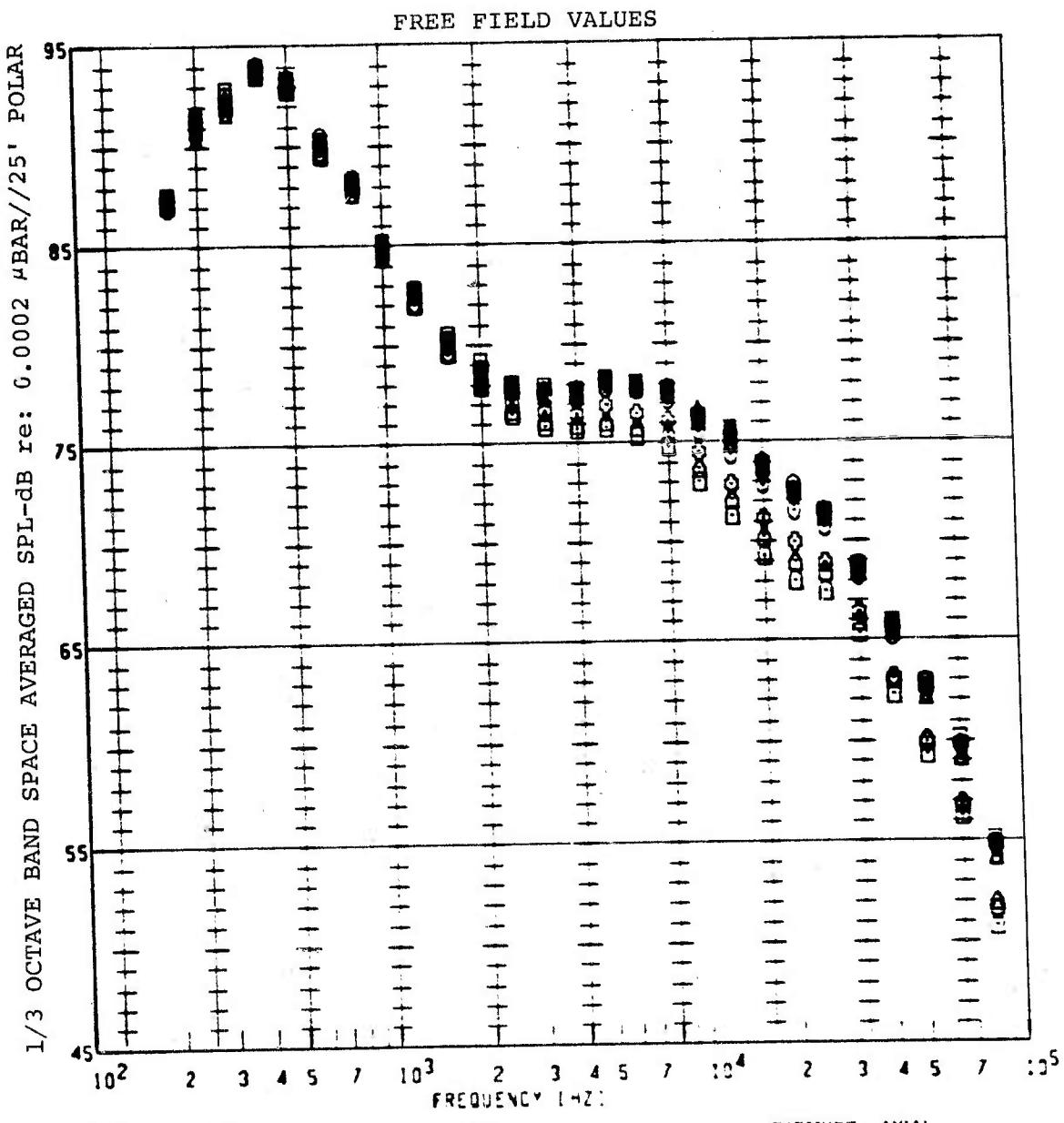
P_{AMB} = 29.92 in Hg **T_{AMB}** = 40° F **R.H.** = 83%

NPR = 3.0 **T_T** = 1150° F **V_{J(IDEAL)}** = 2300 FPS

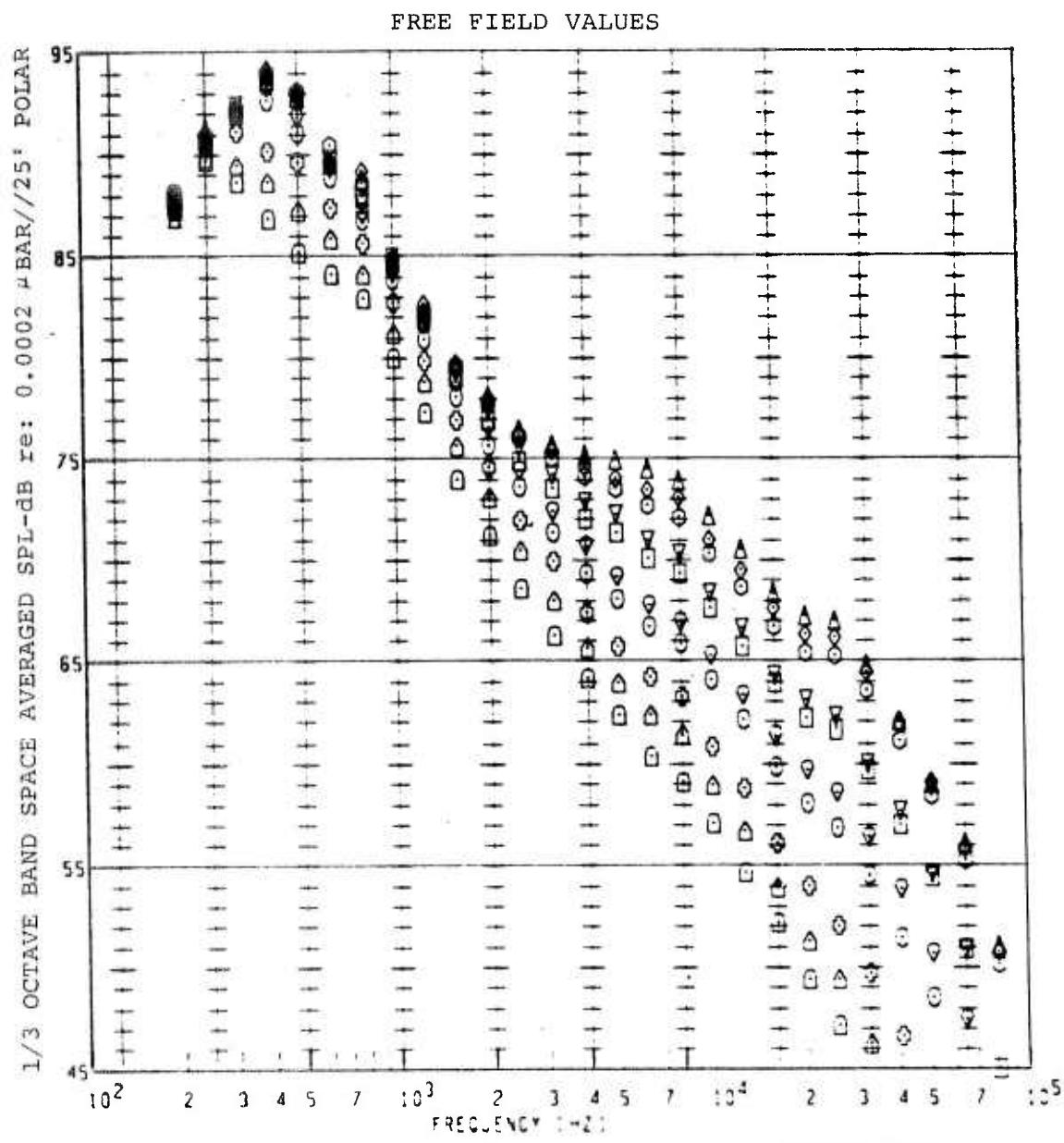
SCALE MODEL A₈ = 13.6 in.²

RUN NO.	AXIAL LOCATION	IRIS DIA.	REMARKS	REF.
99	0.0 x/D	9.0 in.		
100	0.25	9.0		
101	0.50	9.0		
102	0.75	10.0		
103	1.00	10.0		
104	1.25	10.5		
105	1.50	10.5		
106	1.75	11.0		
107	2.00	11.0		
108	2.25	11.5		
109	2.50	11.5		
110	2.75	12.0		
111	3.0	13.0		
112	3.5	14.0		
113	4.0	15.0		
114	5.0	16.0		
115	6.0	18.0		
116	8.0	19.0		
117	10.0	21.0		
118	12.0	23.0		
119	14.0	25.0		
120	160	27.0		

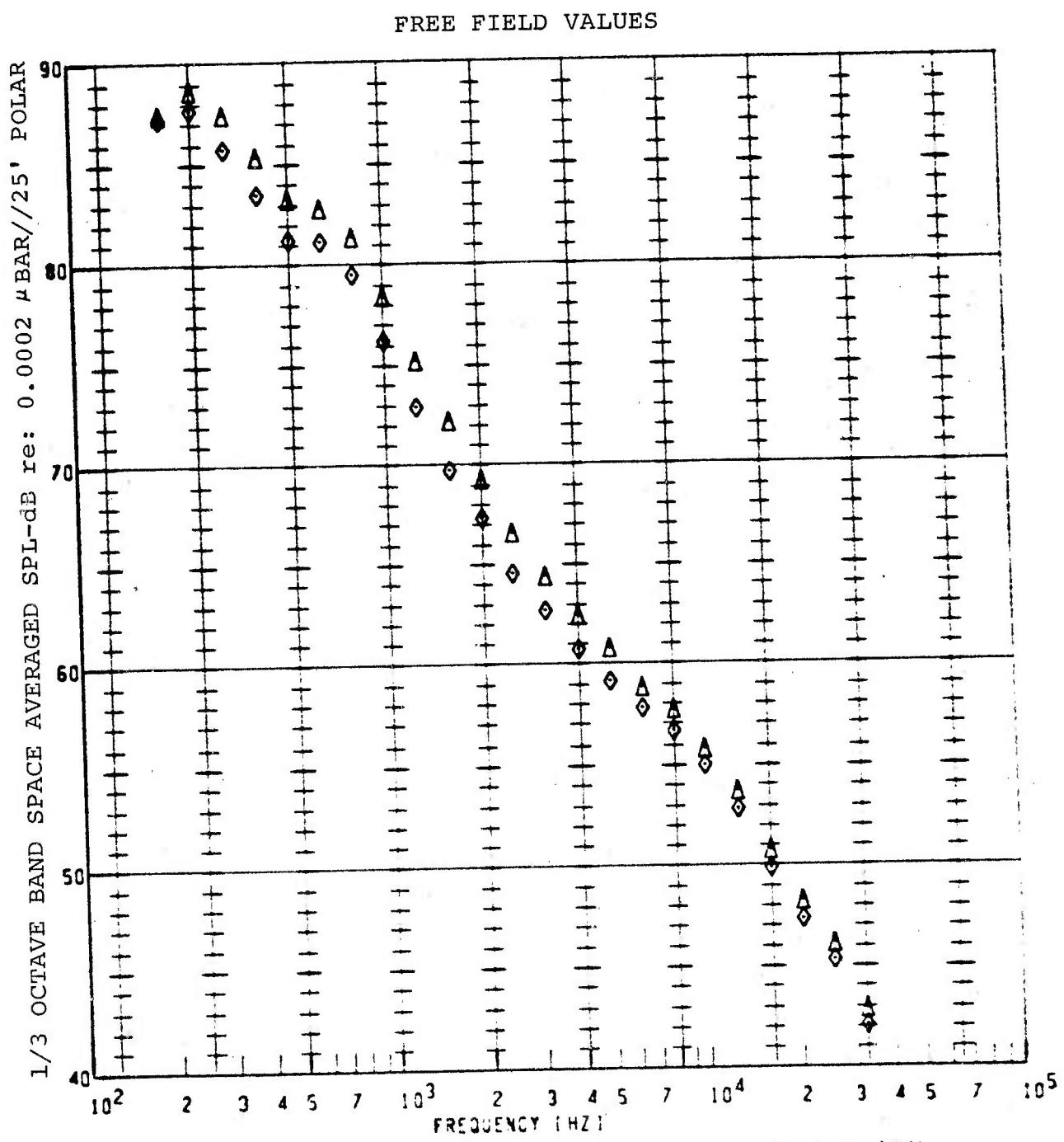
MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

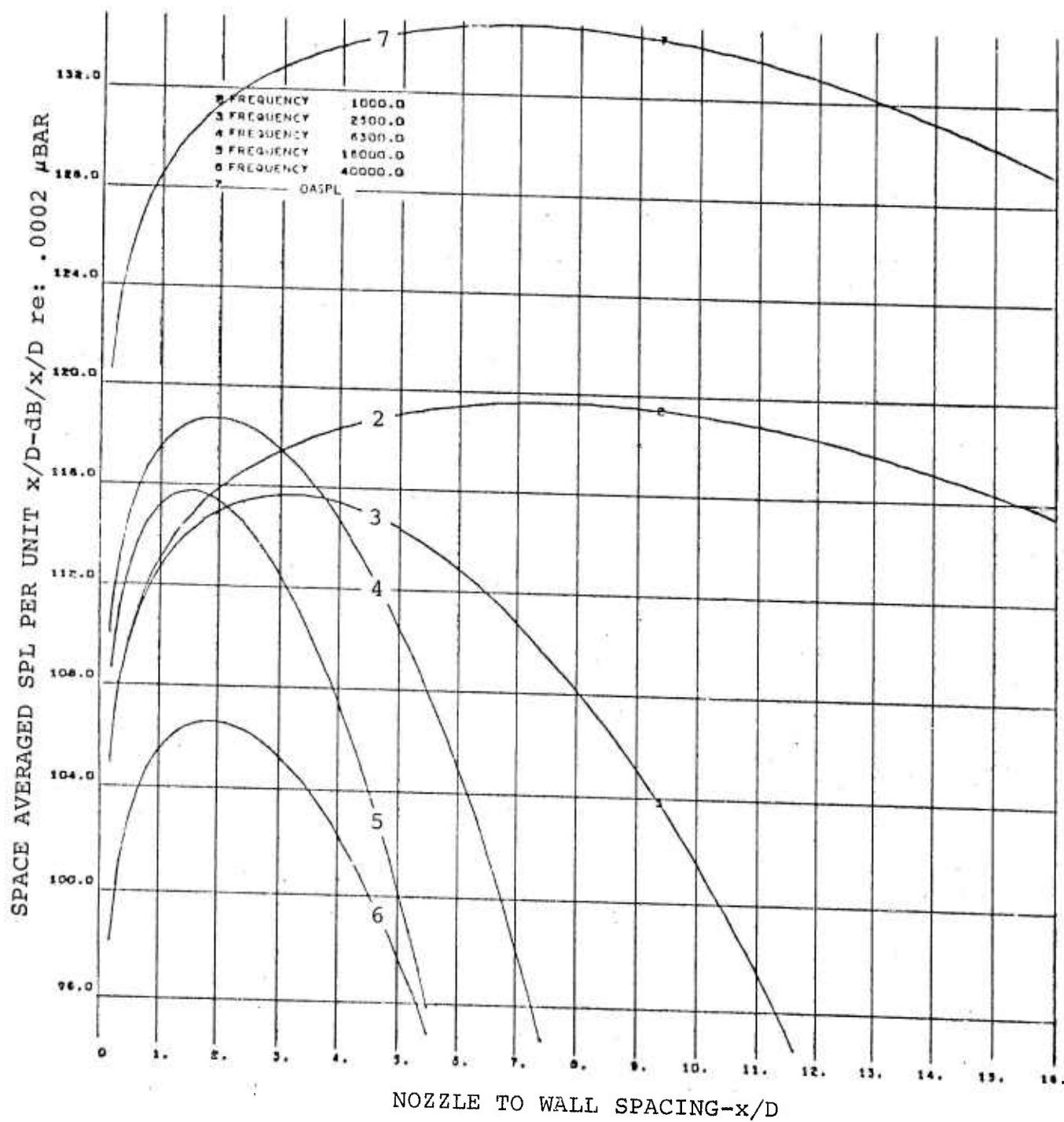


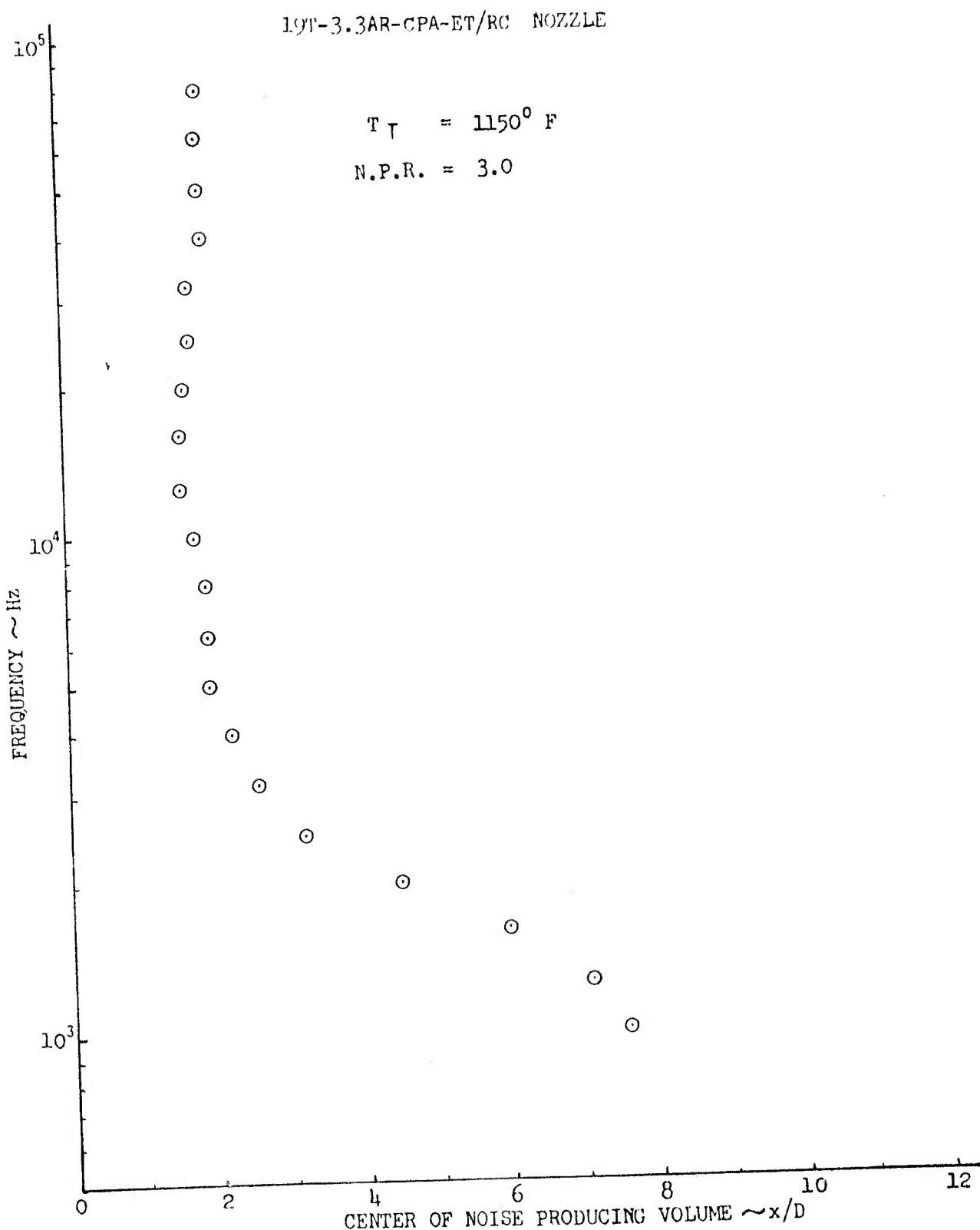
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	99	1150°F	3.000	0.00
○	100	1150	3.000	0.25
○	101	1150	3.000	0.50
○	102	1150	3.000	0.75
○	103	1150	3.000	1.00
○	104	1150	3.000	1.25
○	105	1150	3.000	1.50
○	106	1150	3.000	1.75
○	107	1150	3.000	2.00
○	108	1150	3.000	2.25

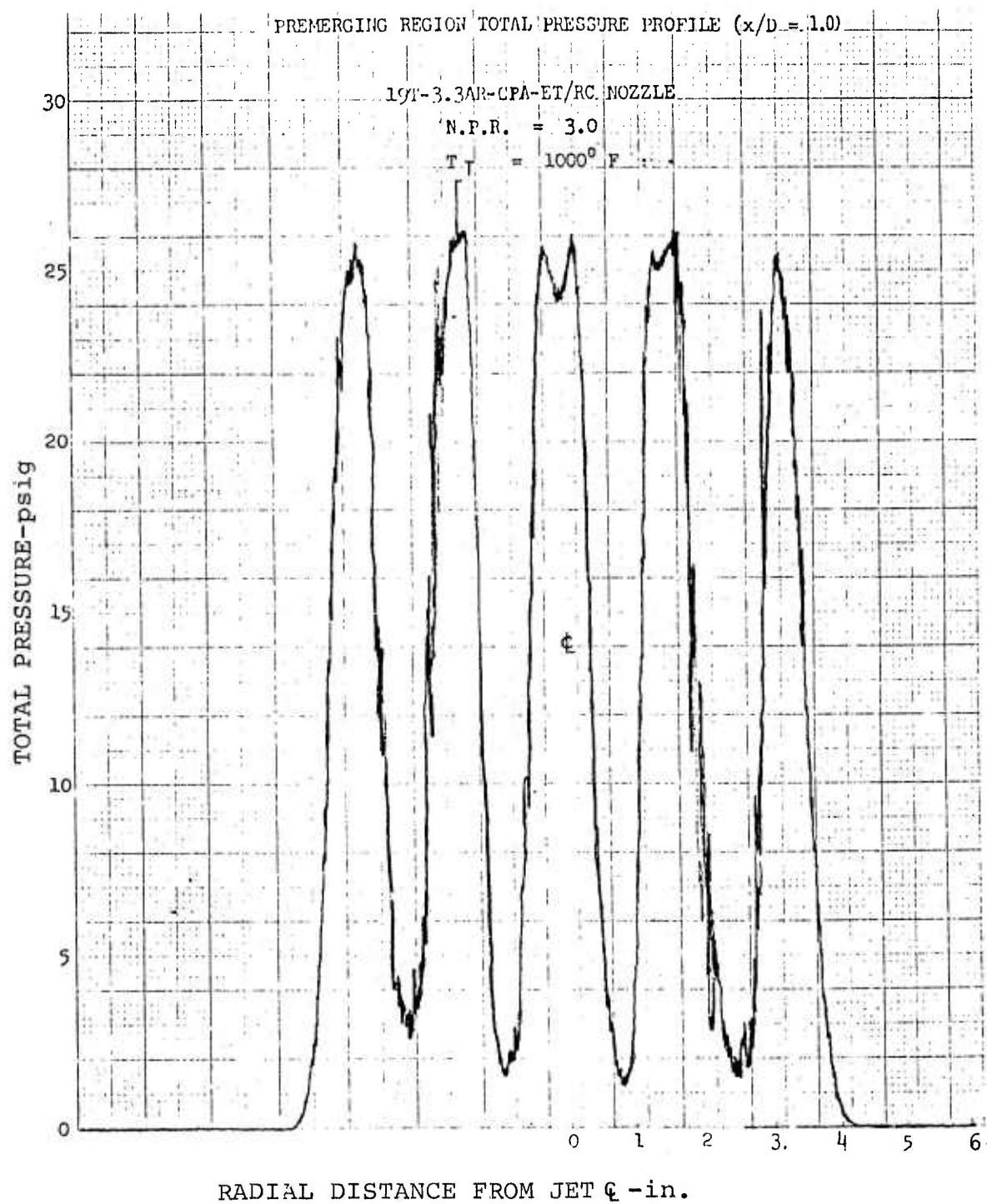


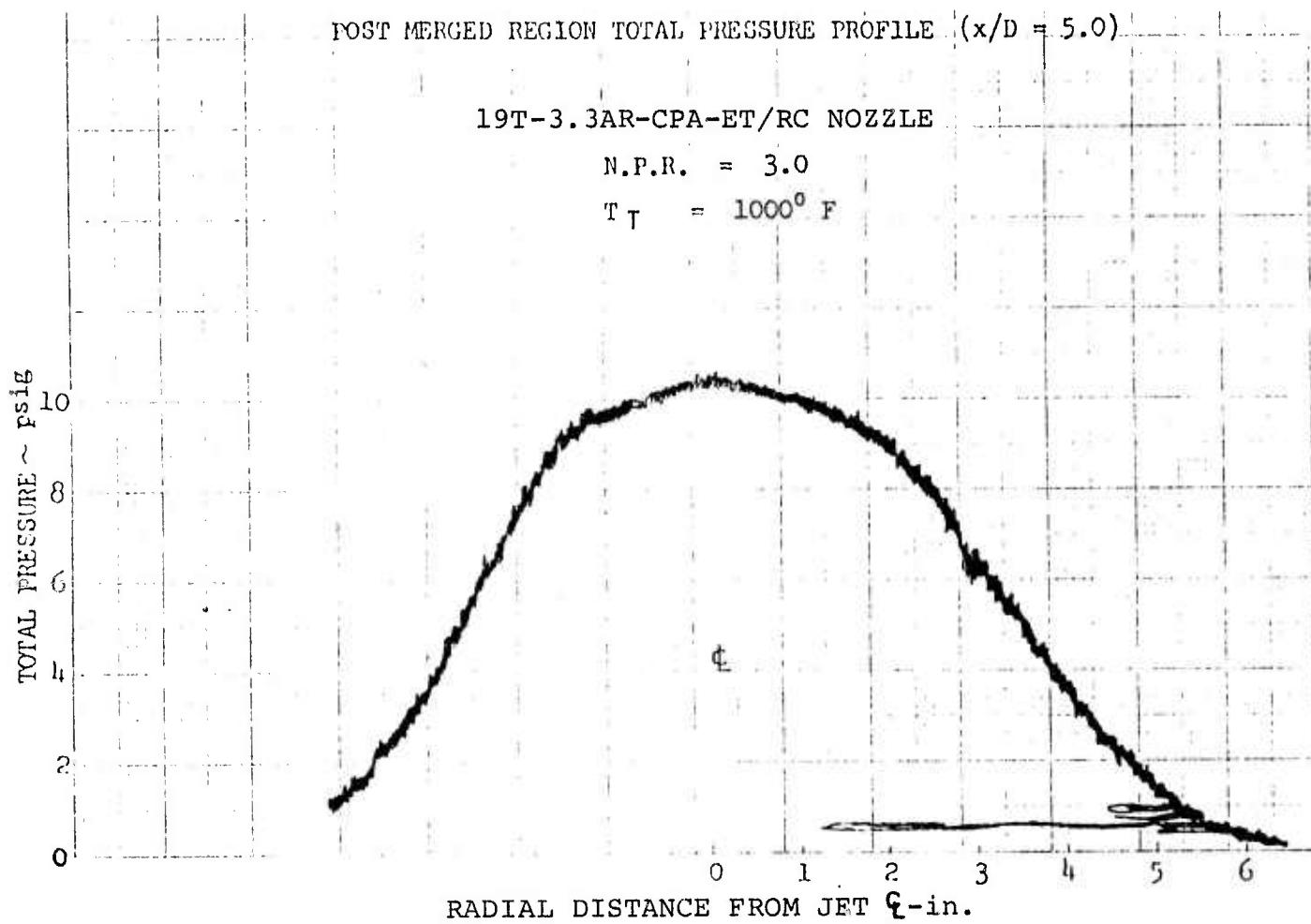
PLOT SYMBOL	RUN NUMBER	TEST	PRESSURE RATIO	AXIAL LOCATION, x/D
▲	119	1150°F	3.000	2.5
○	110	1150	3.000	2.75
△	111	1150	3.000	3.0
▽	112	1150	3.000	3.5
◆	113	1150	3.000	4.0
◆	114	1150	3.000	5.0
◆	115	1150	3.000	6.0
◆	116	1150	3.000	8.0
◆	117	1150	3.000	10.0
◆	118	1150	3.000	12.0

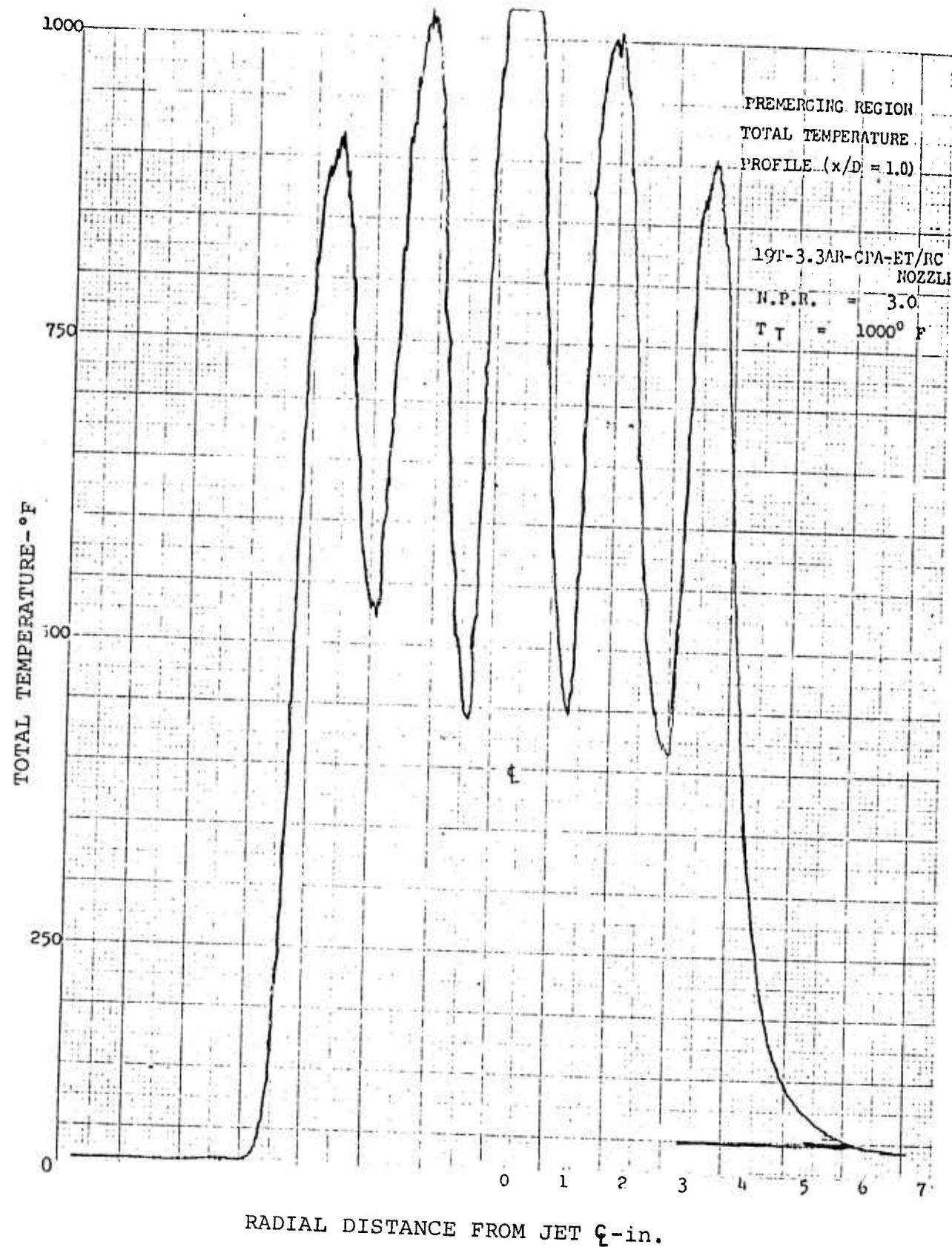


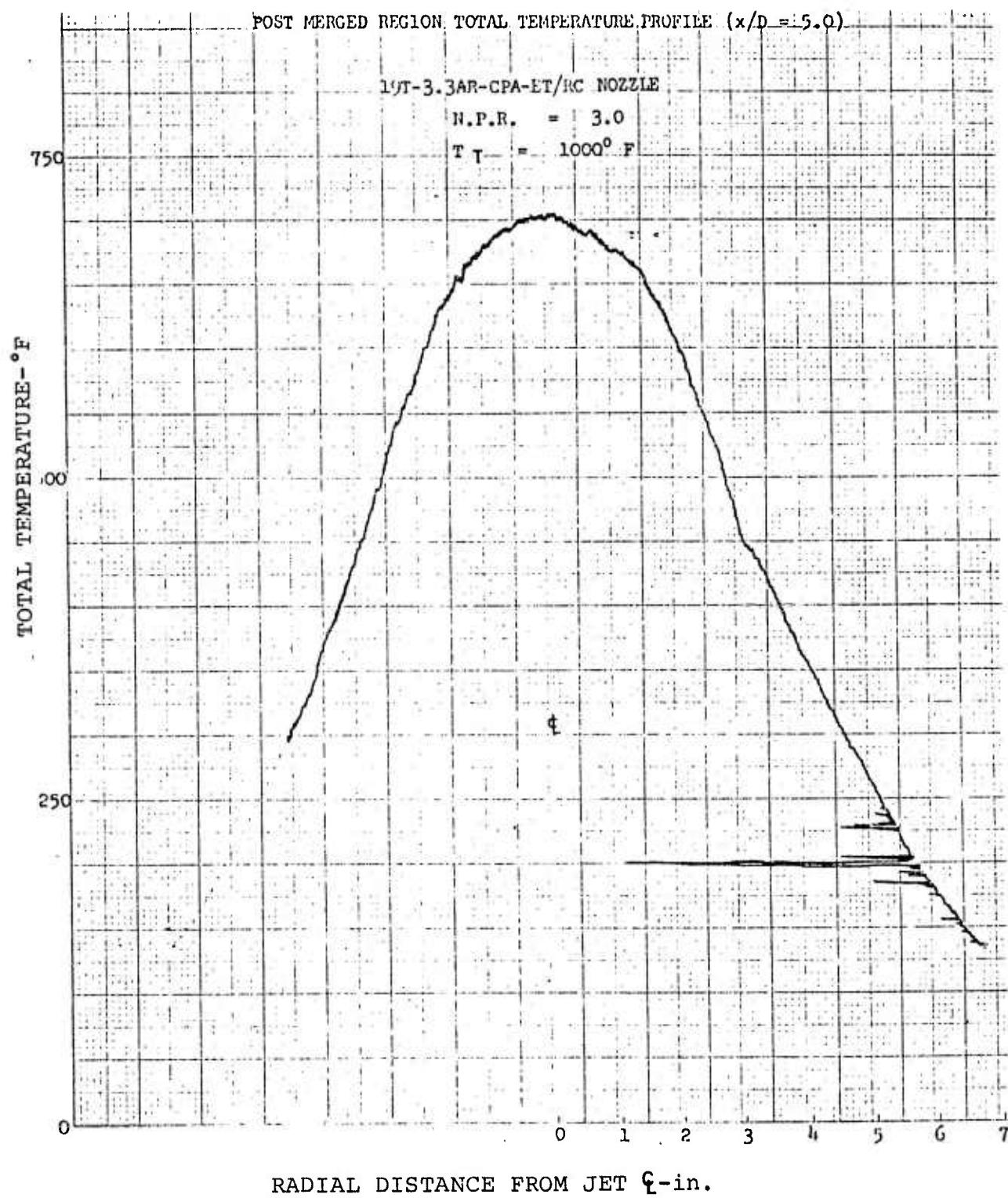


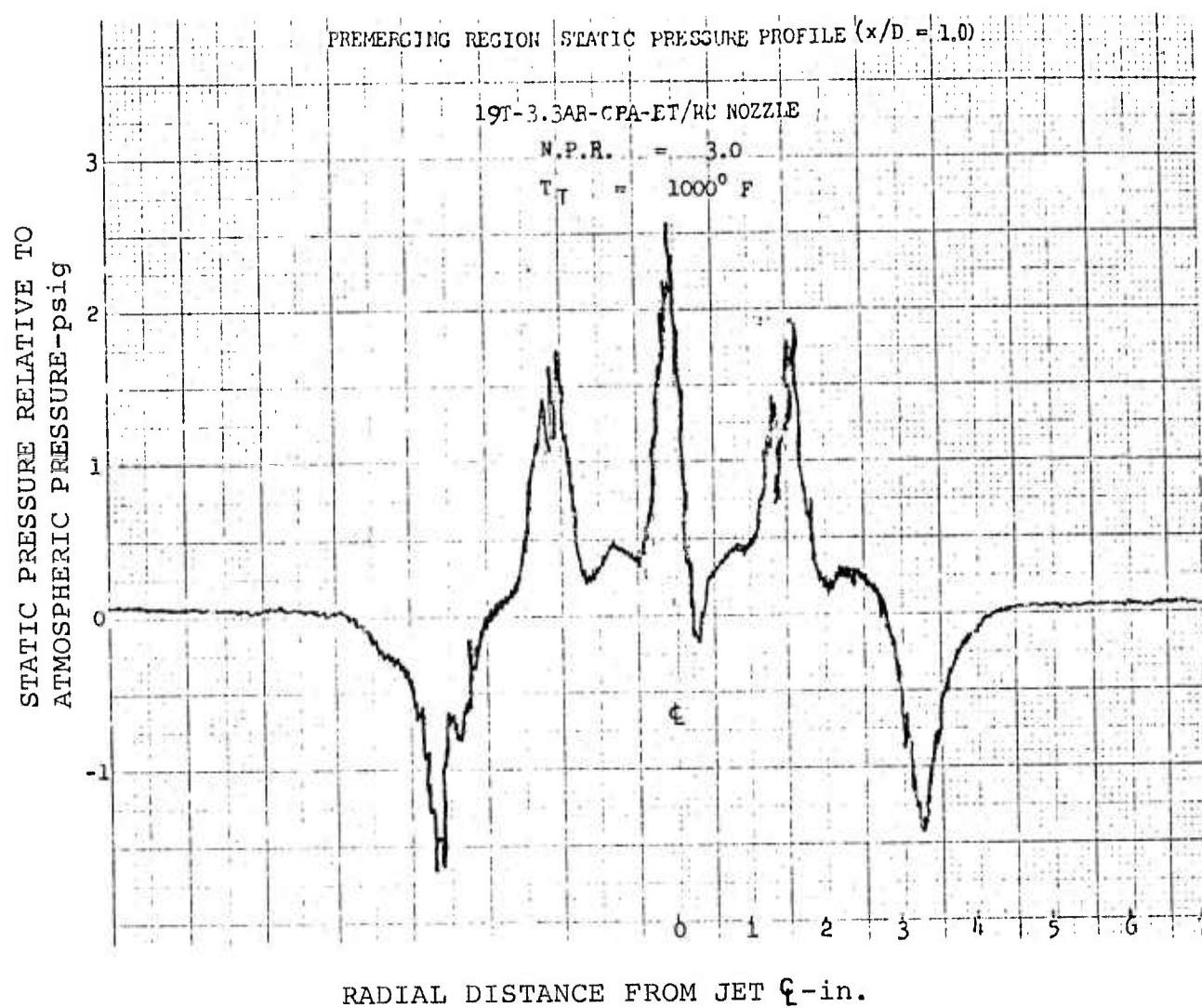








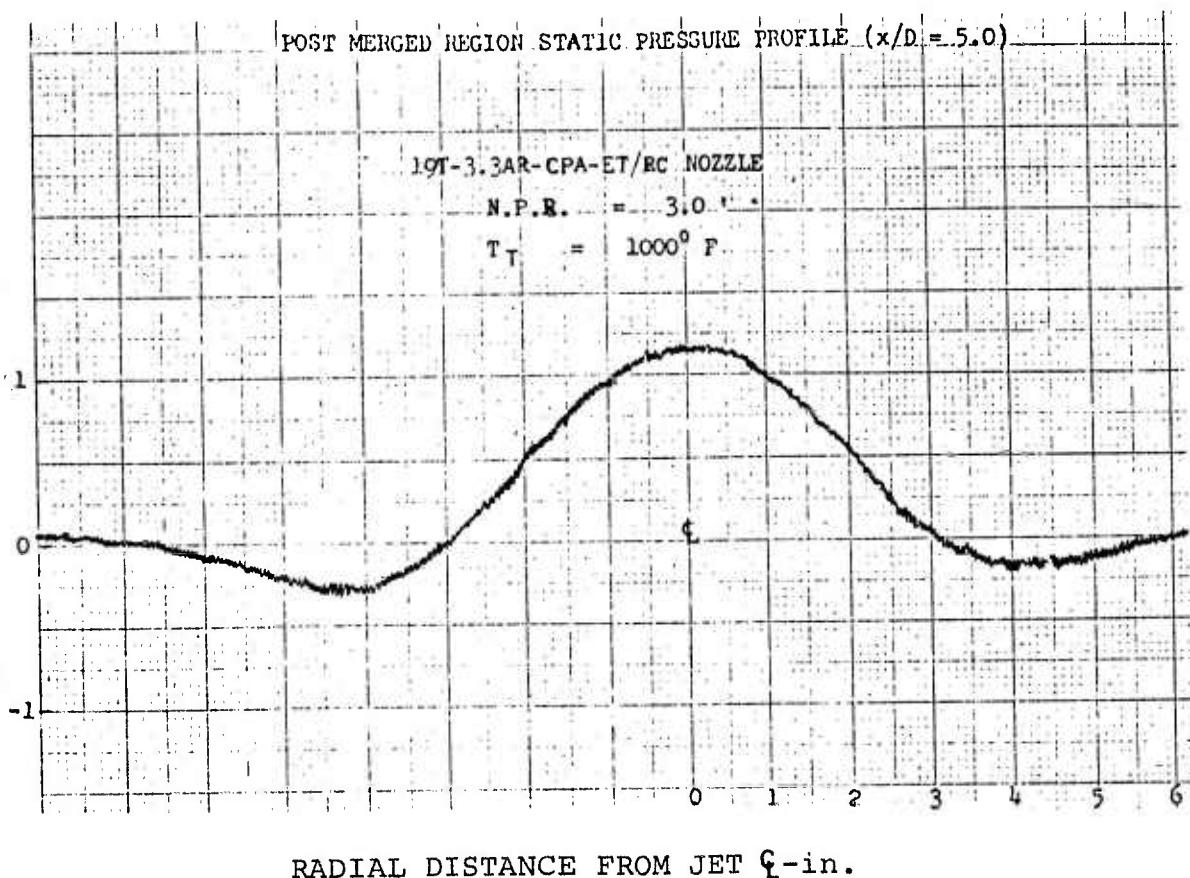




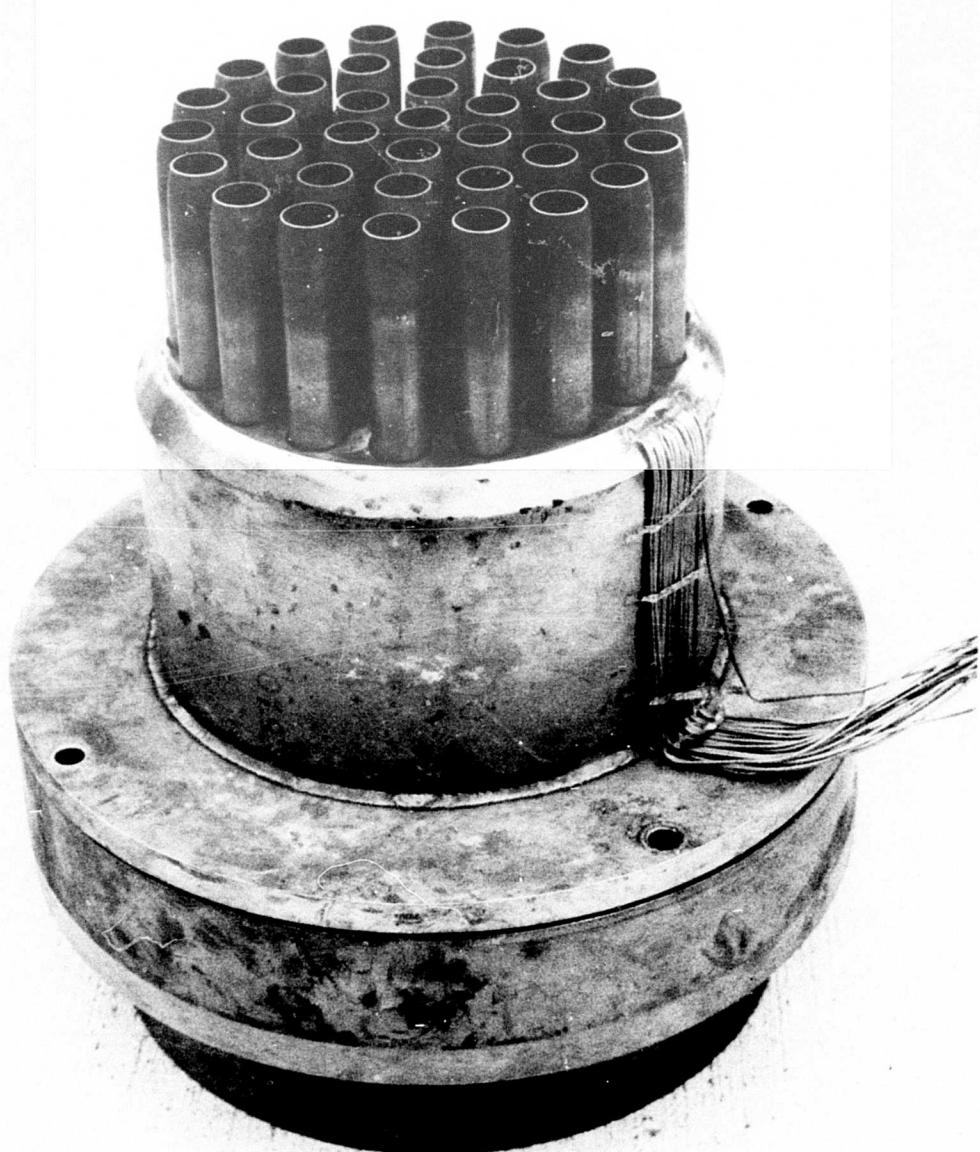
STATIC PRESSURE RELATIVE TO
ATMOSPHERIC PRESSURE-psig

POST MERGED REGION STATIC PRESSURE PROFILE ($x/D = 5.0$)

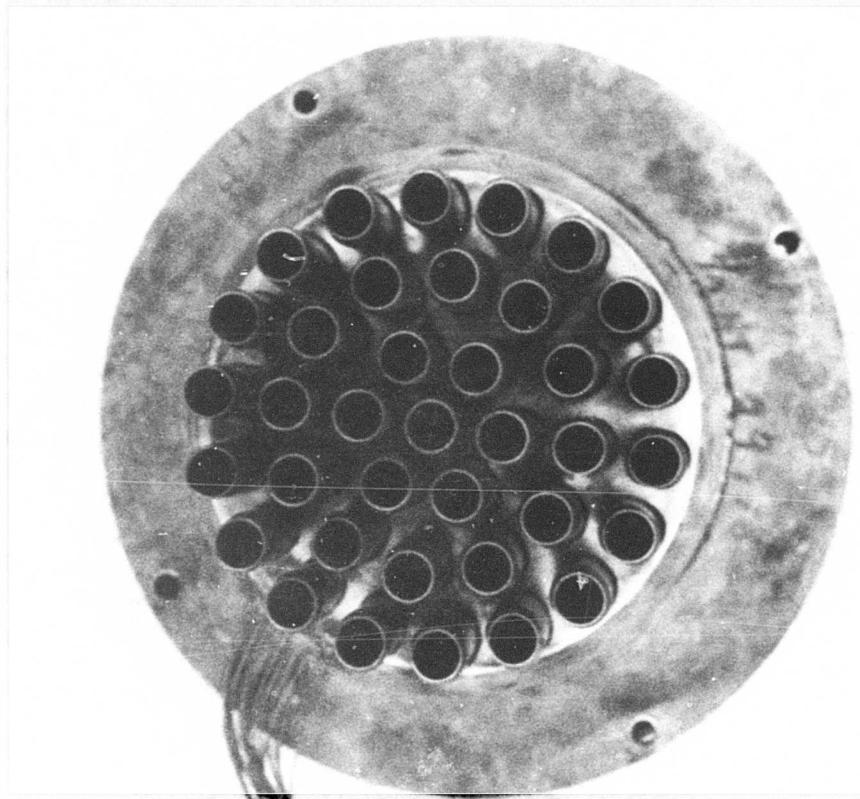
191-3.3AR-CPA-ET/EC NOZZLE
N.P.R. = 3.0
 $T_T = 1000^{\circ} F$



RADIAL DISTANCE FROM JET C-in.



37T-3.3AR-CPA-ET/RC NOZZLE



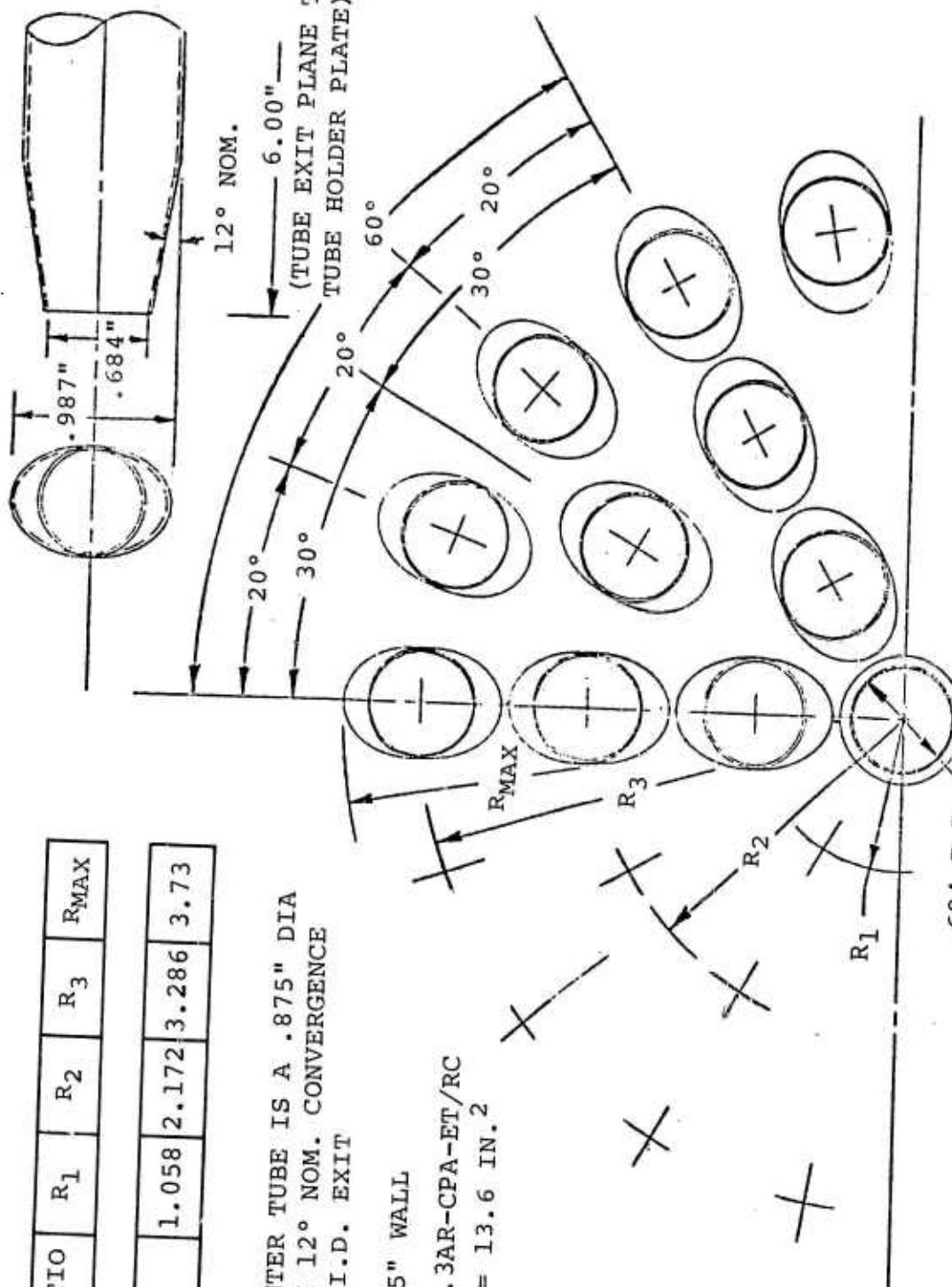
37T-3 .3AR-CPA-ET/RC NOZZLE

AREA RATIO	R ₁	R ₂	R ₃	R _{MAX}
3.3	1.058	2.172	3.286	3.73

NOTE: CENTER TUBE IS A .875" DIA
TUBE WITH 12° NOM. CONVERGENCE
TO .684" I.D. EXIT

MAT'L-.035" WALL

$$37T-3.3AR-CPA-ET/RC \\ A_8 = 13.6 \text{ IN.}^2$$



37 TUBE - AREA RATIO 3.3, ELLIPTICAL TUBES CLOSE ARRAY

TEST CONDITIONS

NOZZLE: 37T-3.3AR-CPA-ET/RC

FACILITY: HNTF

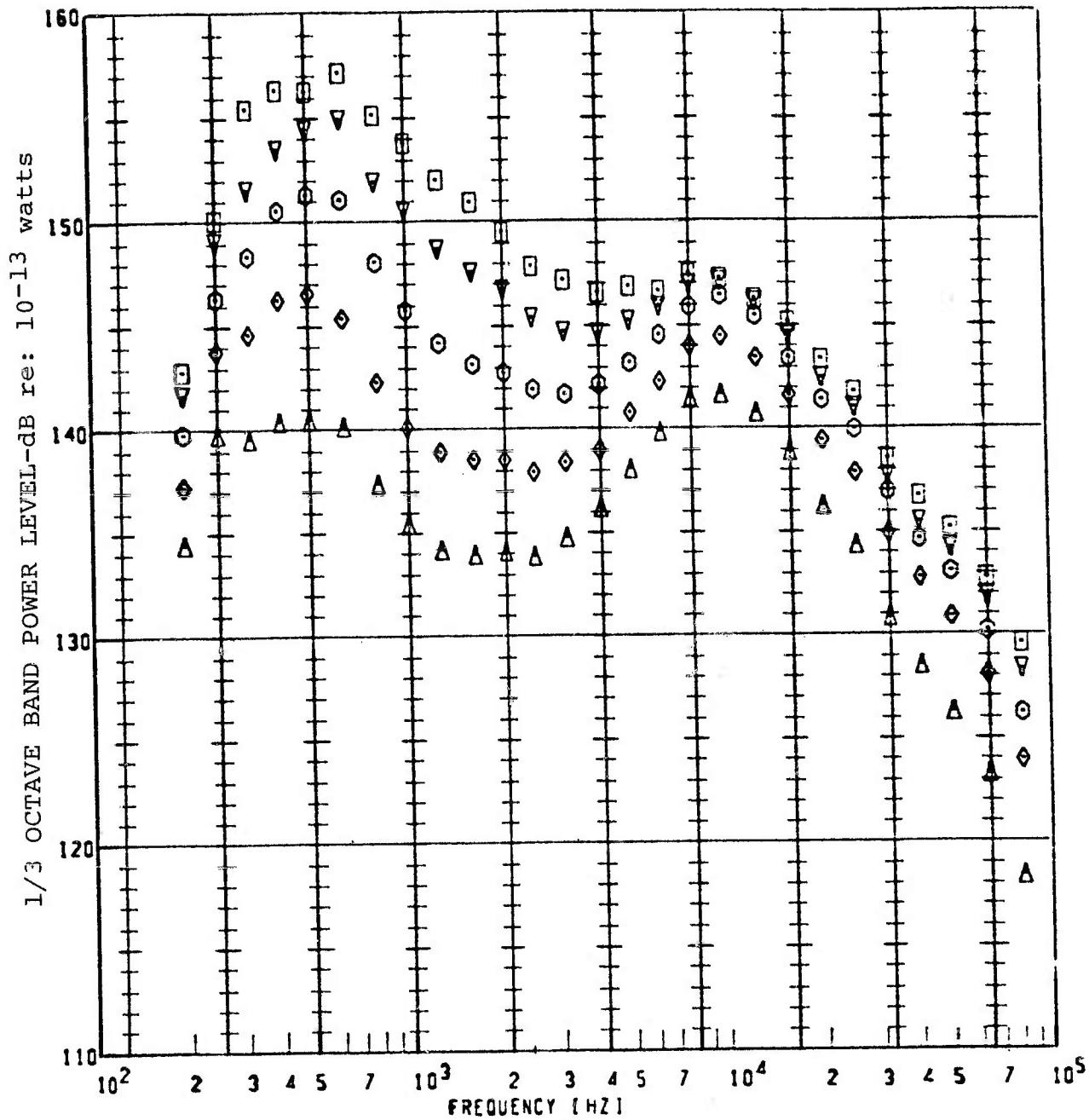
DATE: 6-11-73 **T_{AMB}** = 60 °F **R.H.** = 58%

SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
6	2.0	1150 °F	1875 fps	6" tube lengths	
"	2.5	"	2126		
"	3.0	"	2303		
"	3.5	"	2437		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

FREE FIELD VALUES

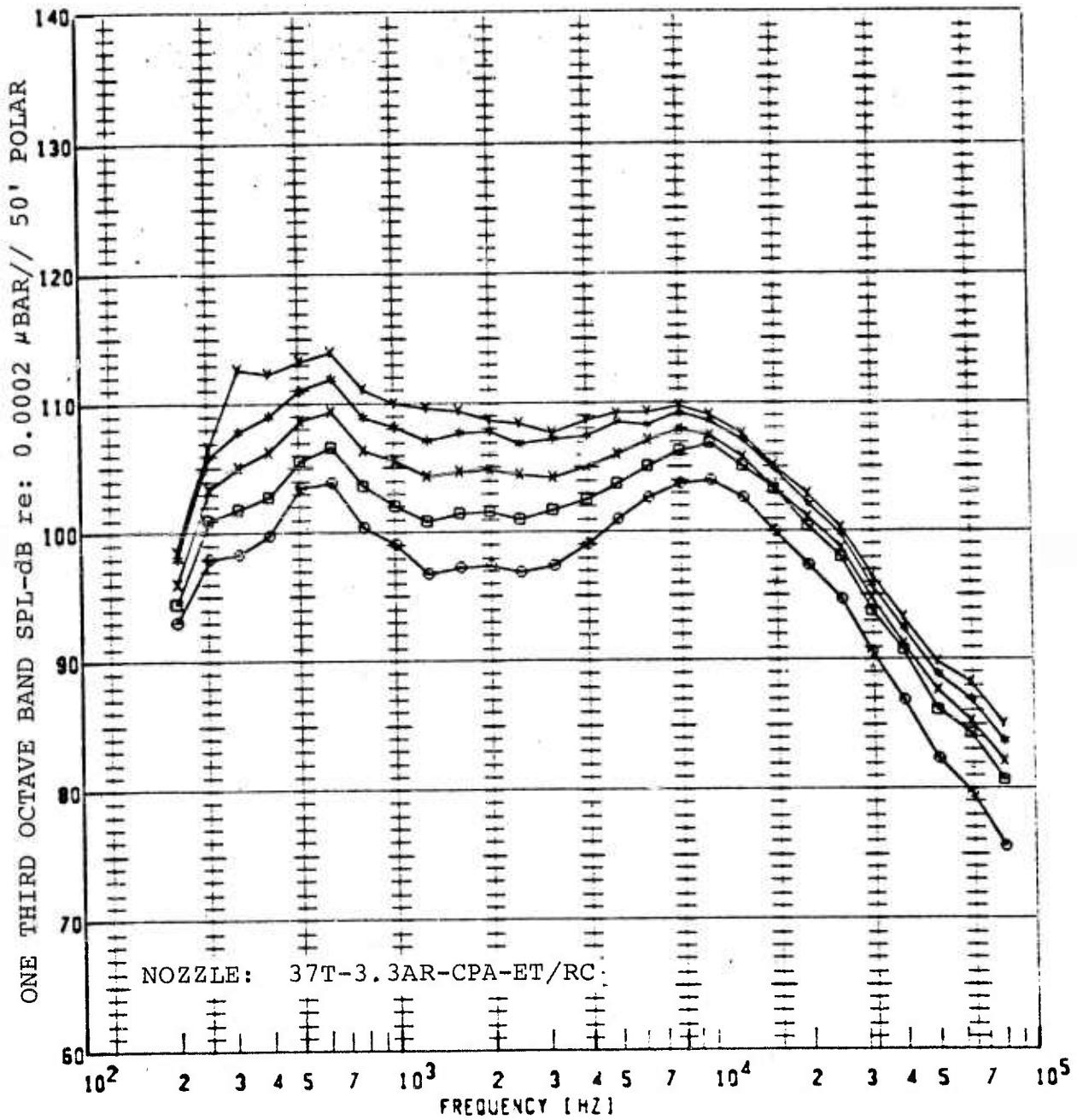


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	005	2.00	1150°F
◊	006	2.50	1150
○	006	3.00	1150
▽	006	3.50	1150
□	006	4.00	1150

NOZZLE: 37T-3.3AR-CPA-ET/RC

JET NOISE POWER SPECTRA

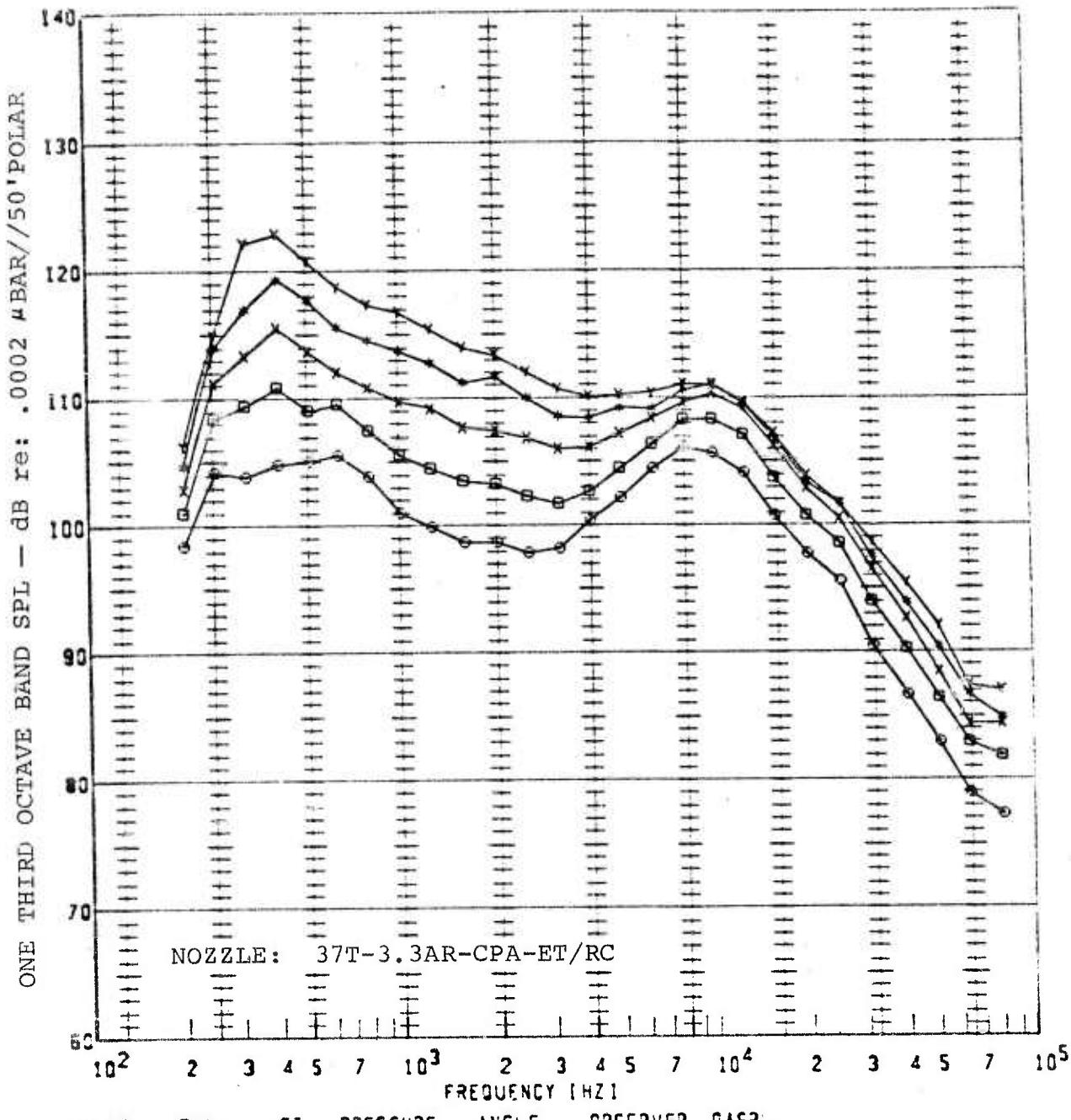
SPECTRA ARE FREE FIELD + 6dB



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL
G	0060	1150°F	2.000	110°	SOFP	113.8
G	0060	1150	2.500		SOFP	115.6
X	0060	1150	3.000		SOFP	119.1
*	0060	1150	3.500	↓	SOFP	121.3
Y	0060	1150	4.000	↓	SOFP	123.0

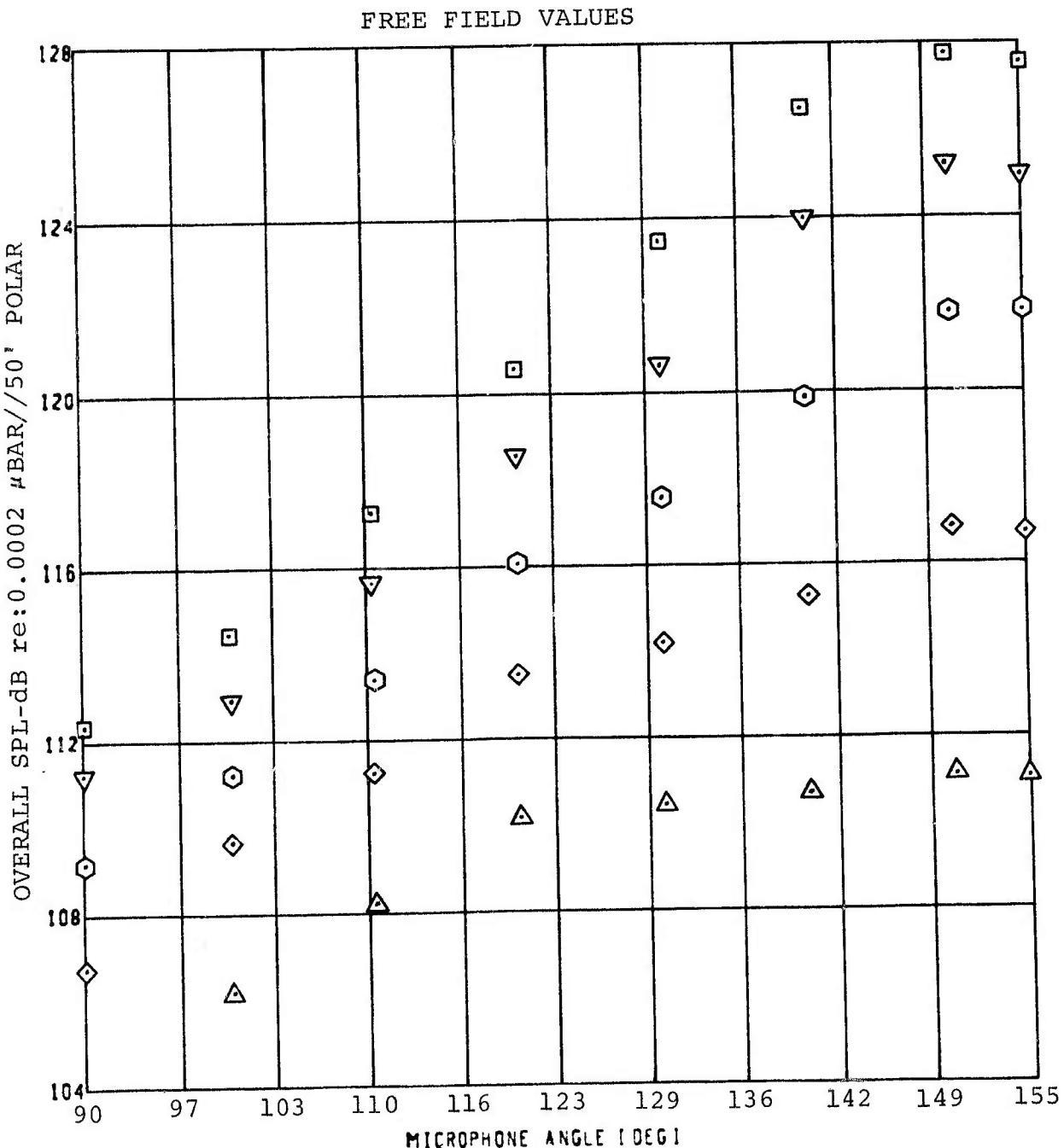
MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

SPECTRA ARE FREE FIELD + 6dB



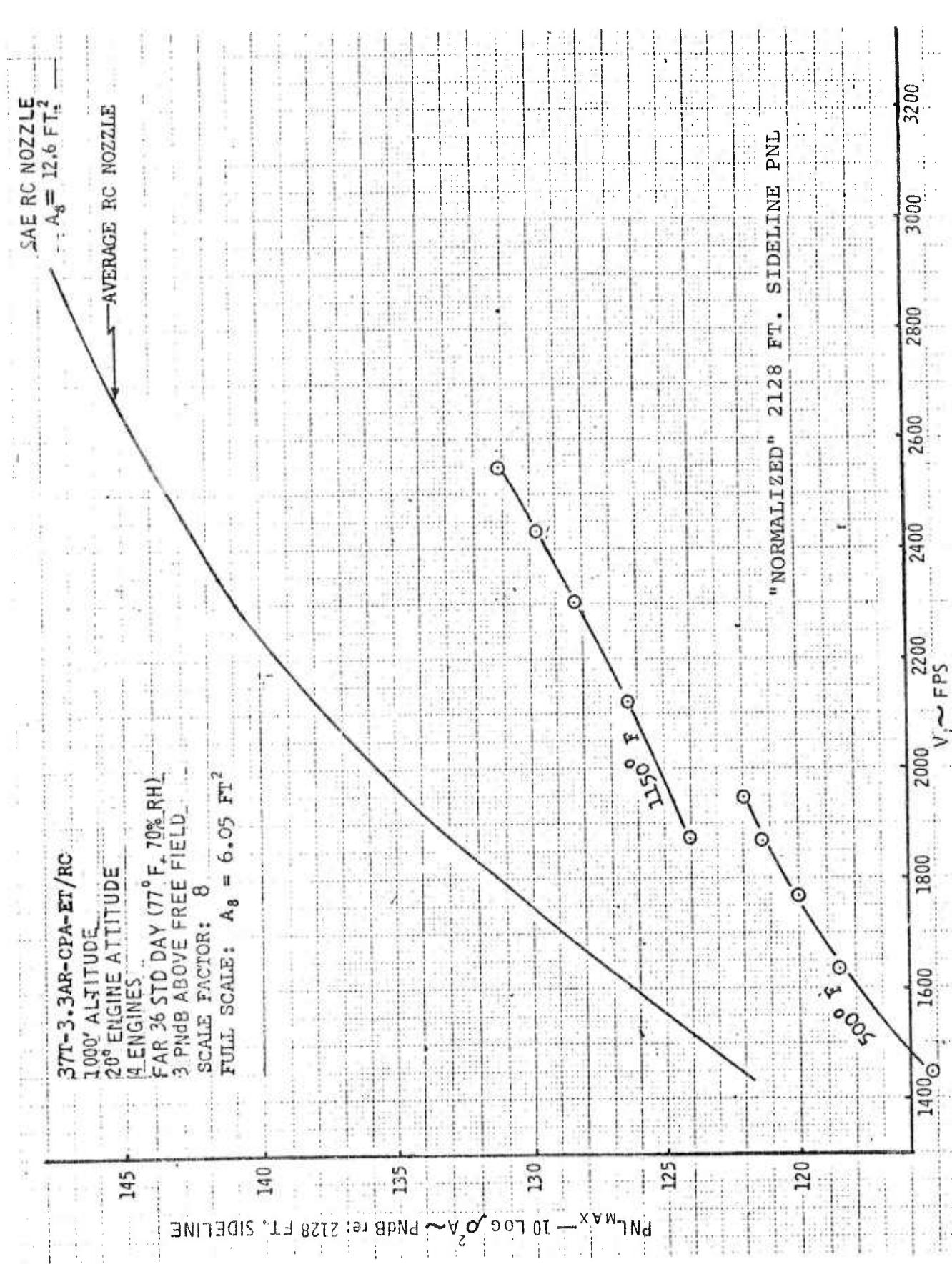
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	GASP
o	006G	1150°F	2.000	130°	SOFP	116.1
□	006G	1150	2.500		SOFP	119.9
x	006G	1150	3.000		SOFP	123.3
*	006G	1150	3.500		SOFP	126.4
Y	006G	1150	4.000		SOFP	129.4

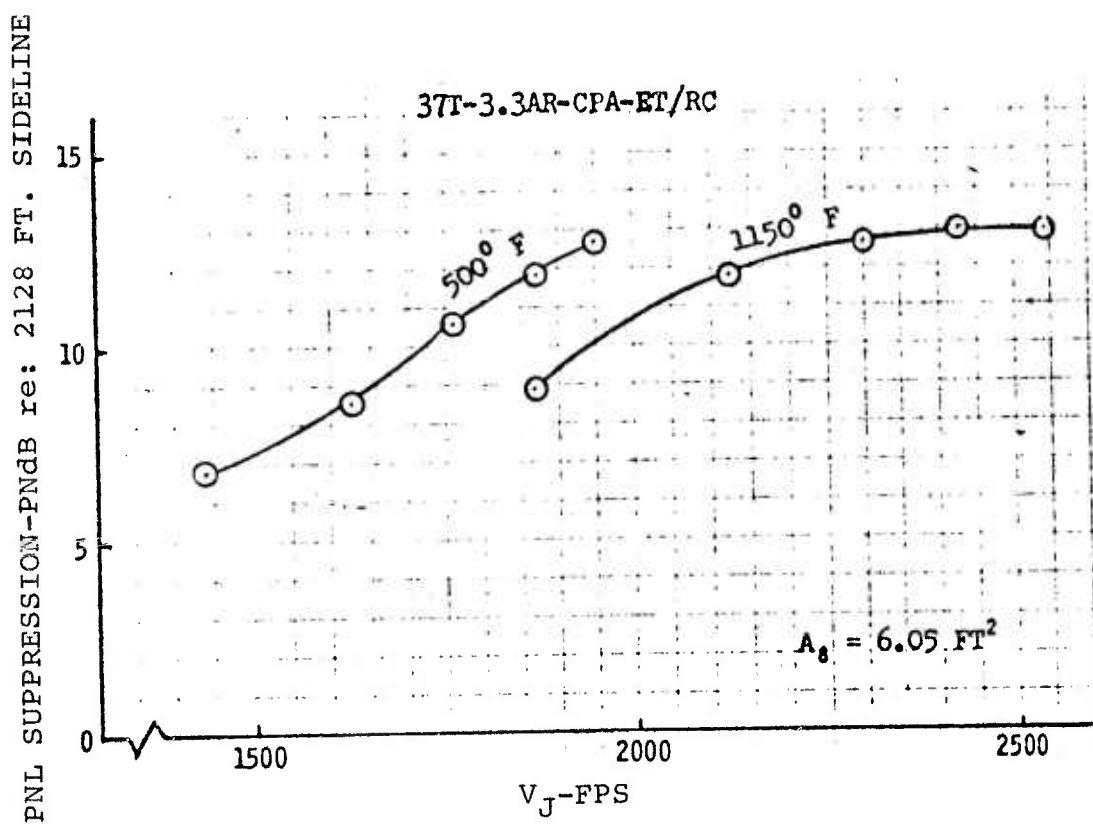
MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



NOZZLE: 37T-3.3AR-CPA-ET/RC

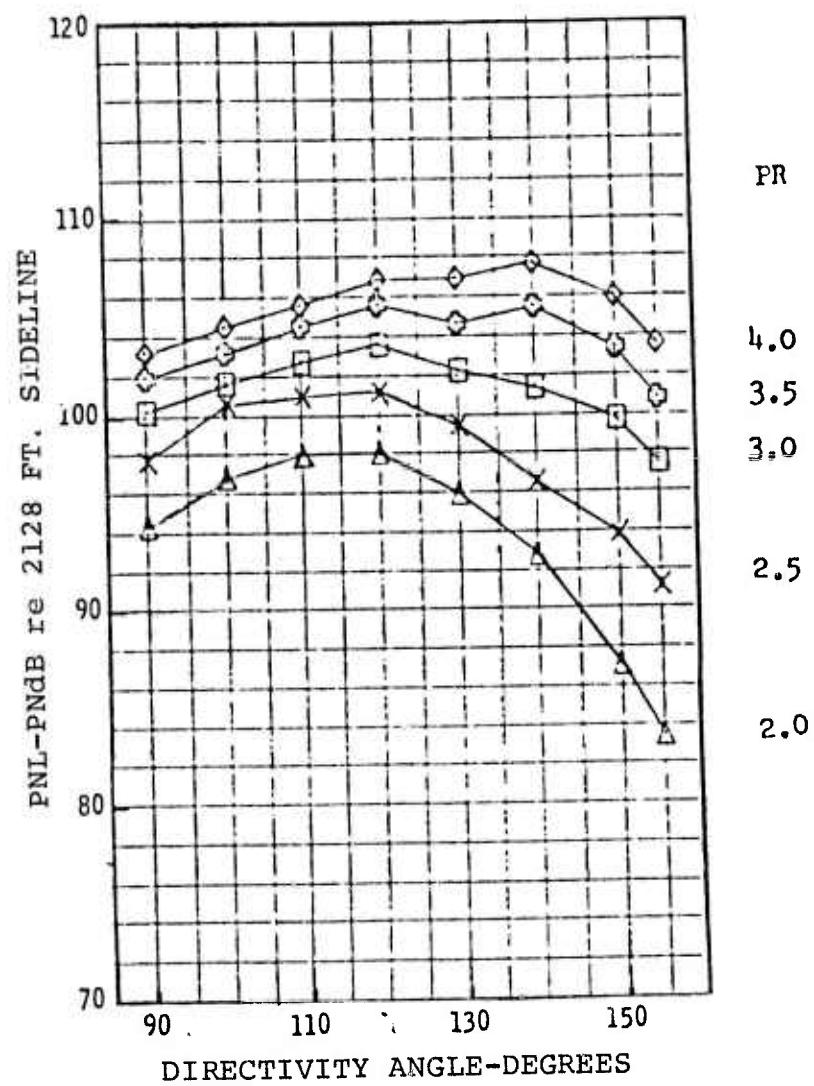
OASPL BEAM PATTERNS





PEAK PNL SUPPRESSION VALUES

NOZZLE: 37T-3.3AR-CPA-ET/RC



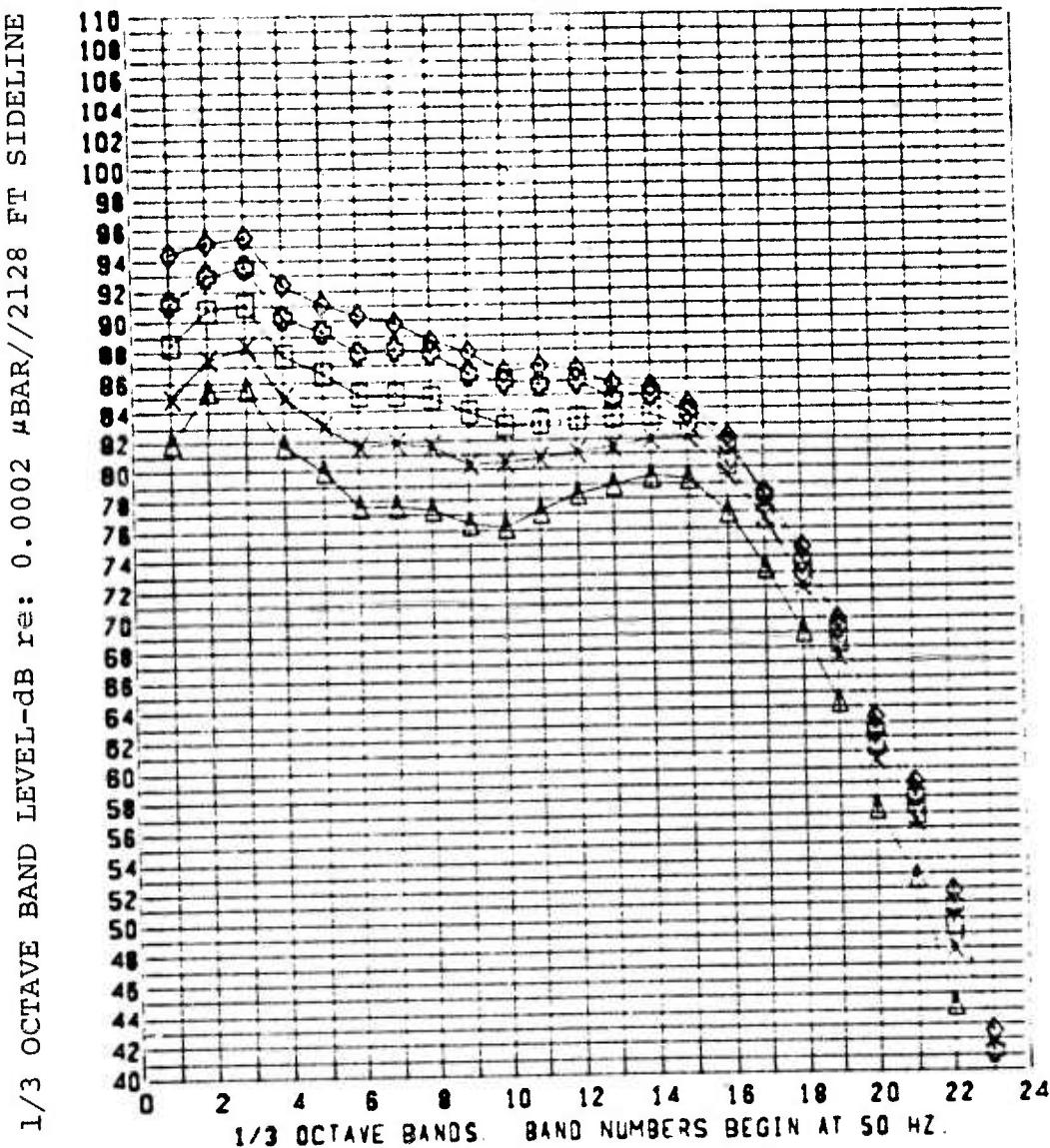
RUN: 006

$T_T = 1150^\circ\text{F}$ $A_8 = 6.05 \text{ FT}^2$

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 006

PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.5, \diamond 4.0

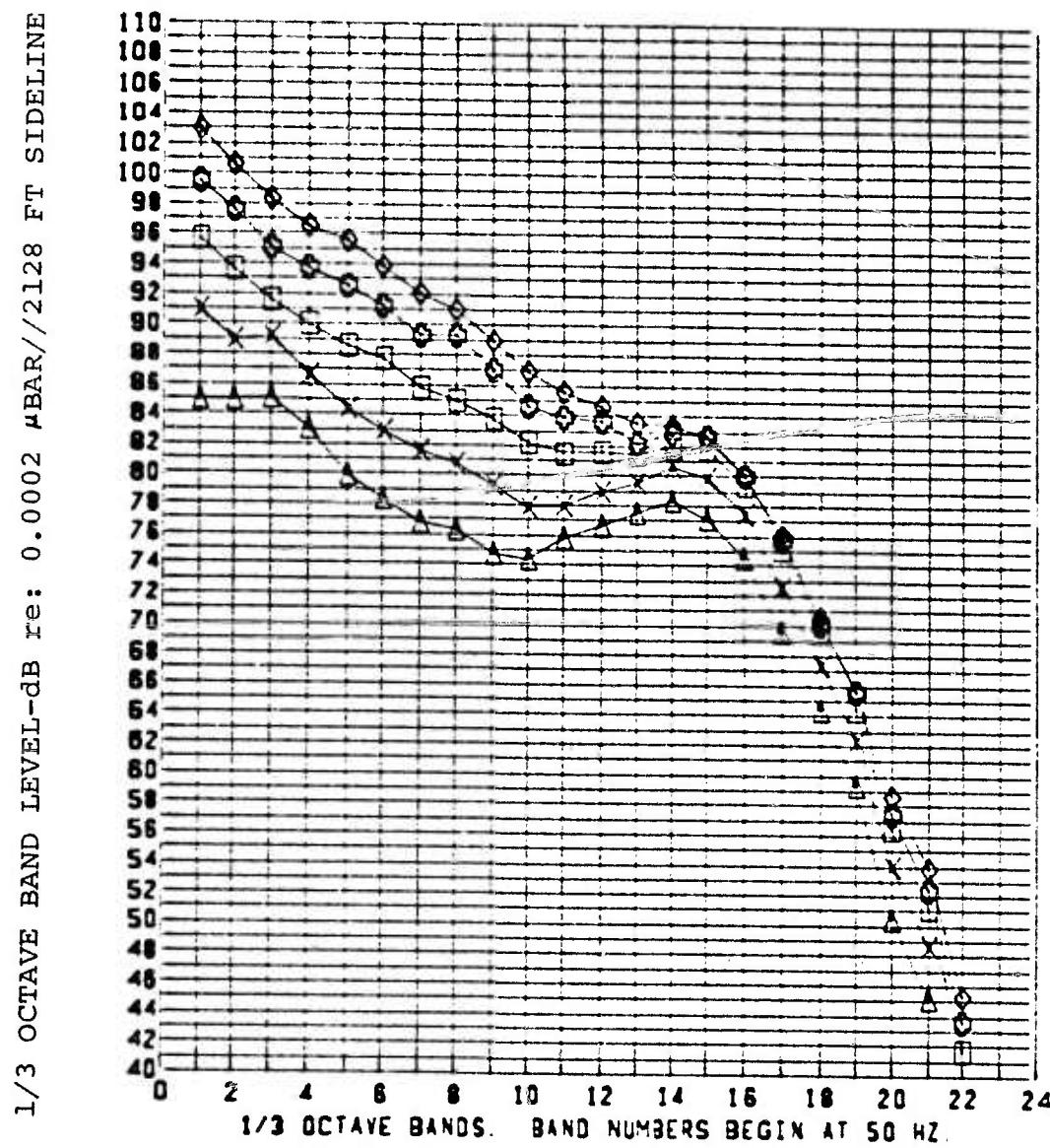
NOZZLE: 37T-3.3AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°

re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



NOZZLE: 37T-3.3AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°
re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 37T-3.3AR-CPA-ET/RC
with 3.1AR Ejector

FACILITY: HNTF

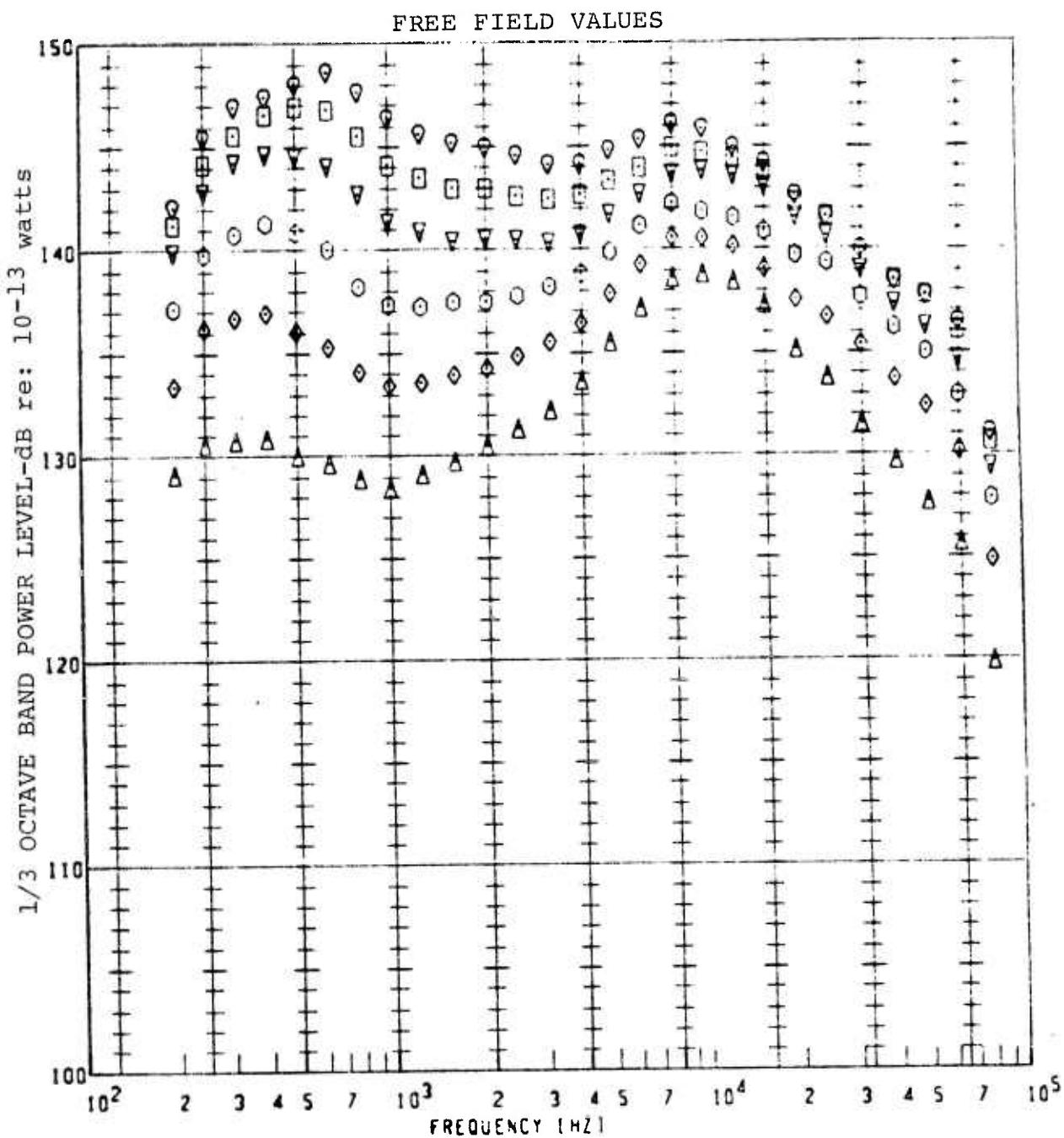
DATE: 8-23-73

T_{AMB} = 54.5°F **R.H.** = 70%

SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
16	2.0	1150°F	1875 fps		
"	2.5	"	2126		
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

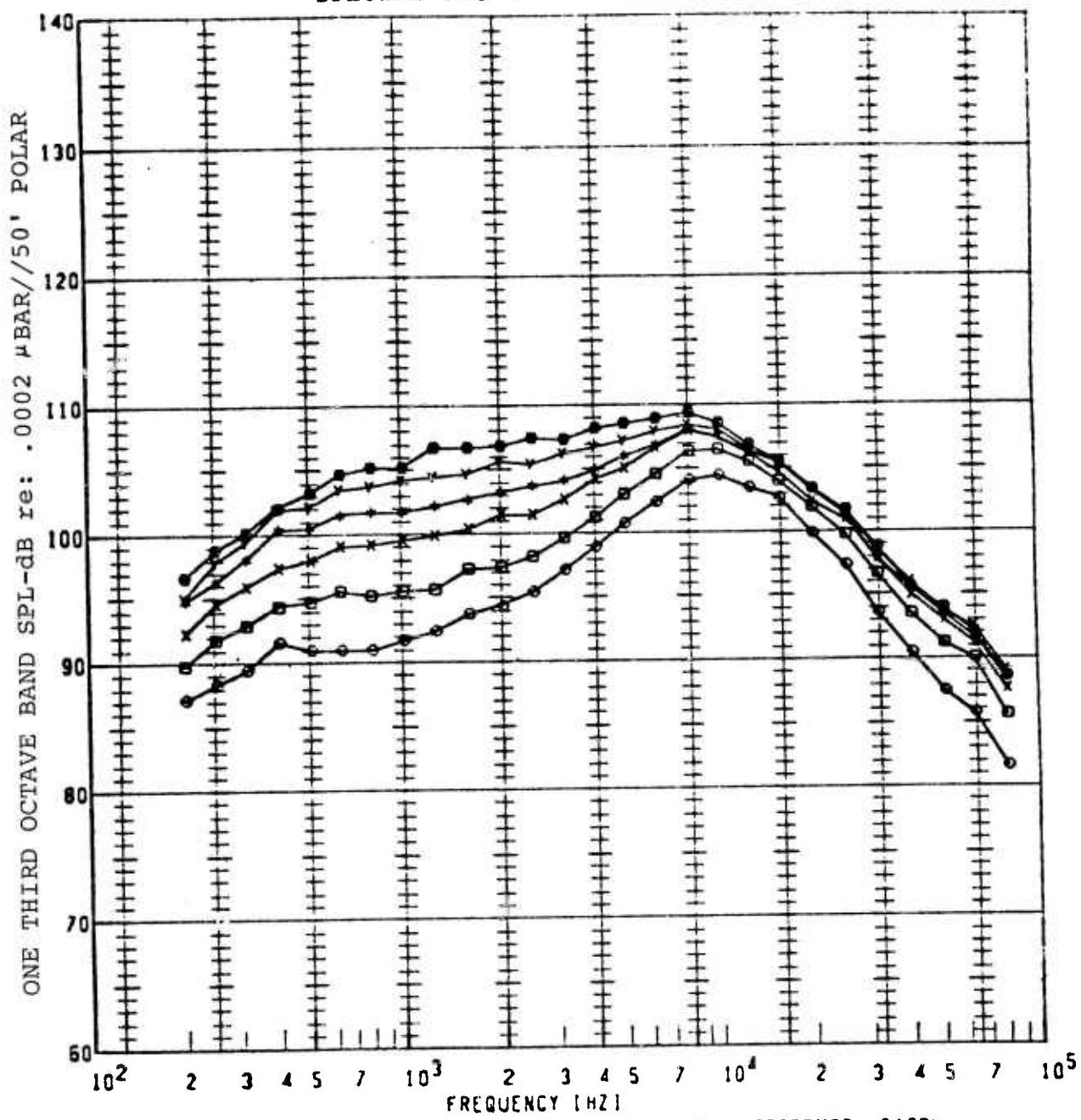


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	16	2.00	1150°F
◊	16	2.50	1150
○	16	3.00	1150
▽	16	3.40	1150
□	16	3.70	1150
◆	16	4.00	1150

37T-3.3AR-CPA-ET/RC
WITH 3.1AR EJECTOR

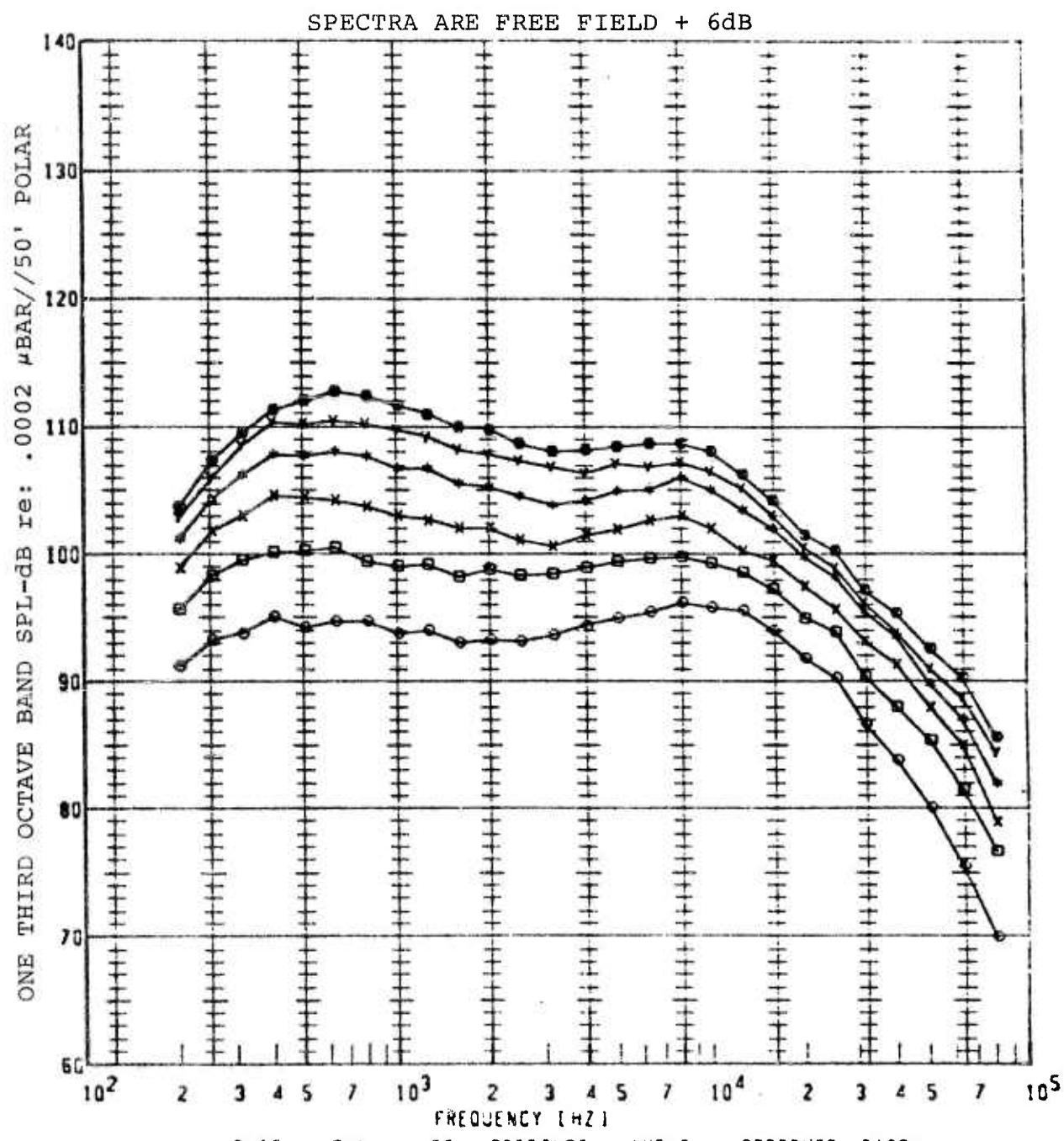
JET NOISE POWER SPECTRA

SPECTRA ARE FREE FIELD + 6dB



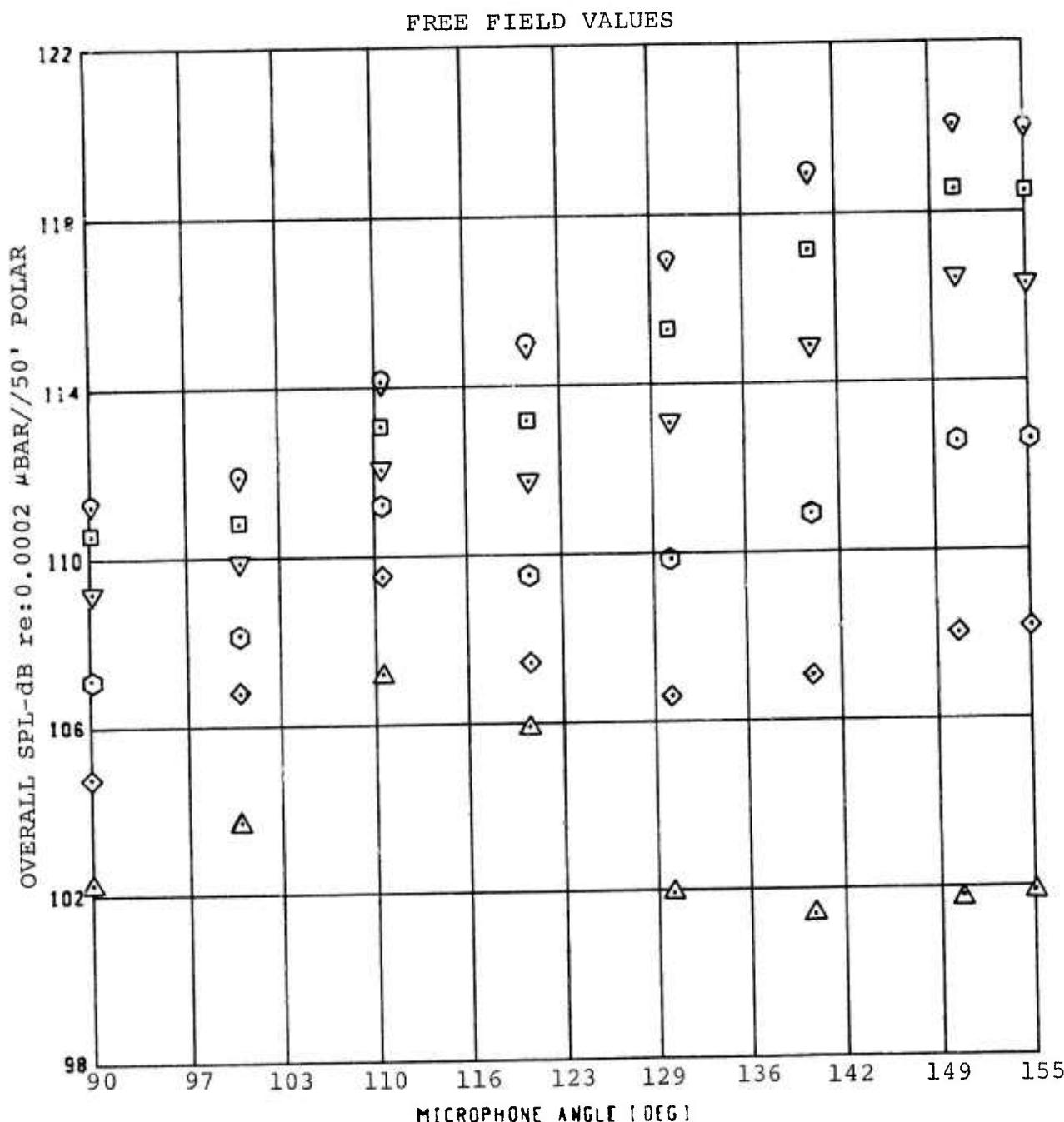
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL (DB)
○	16G	1150°F	2.000	110°	SOFP	112.4
□	16G	1150	2.500		SOFP	114.7
×	16G	1150	3.000		SOFP	116.5
*	16G	1150	3.400		SOFP	117.4
Y	16G	1150	3.700		SOFP	118.6
●	16G	1150	4.000		SOFP	119.6

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

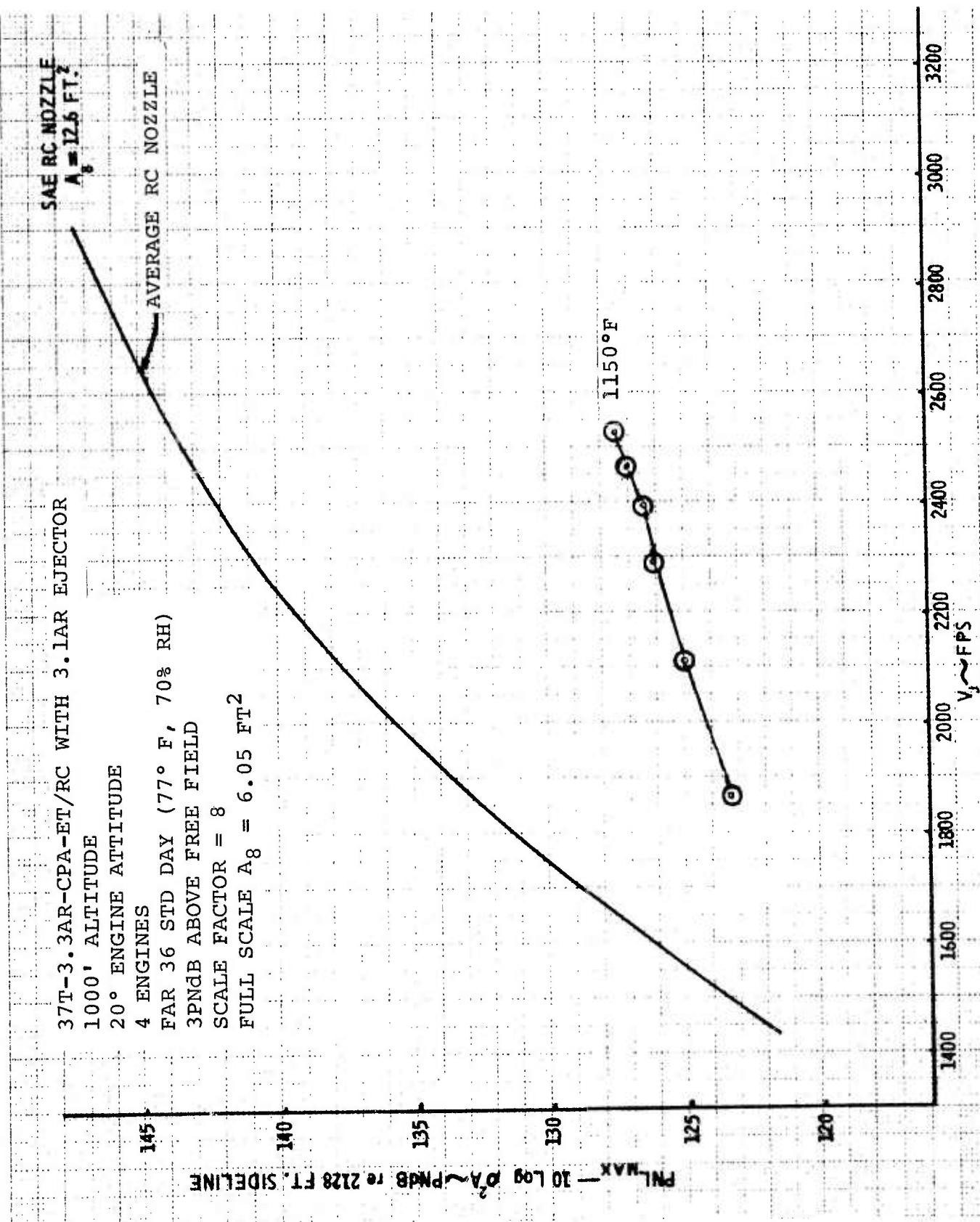


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL (dB)
○	16G	1150°F	2.000	130°F	SQFP	107.6
□	16G	1150	2.500		SQFP	112.2
x	16G	1150	3.000		SQFP	115.6
*	16G	1150	3.400		SQFP	118.8
v	16G	1150	3.700		SQFP	121.1
●	16G	1150	4.000		SQFP	122.7

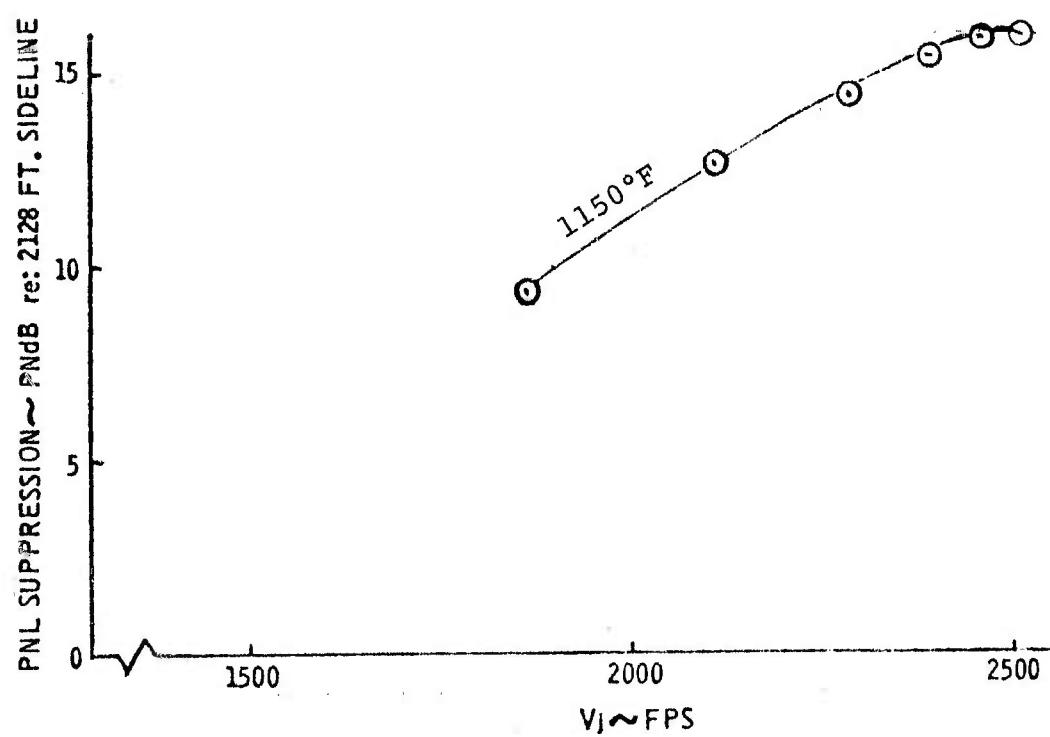
MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



OASPL BEAM PATTERNS

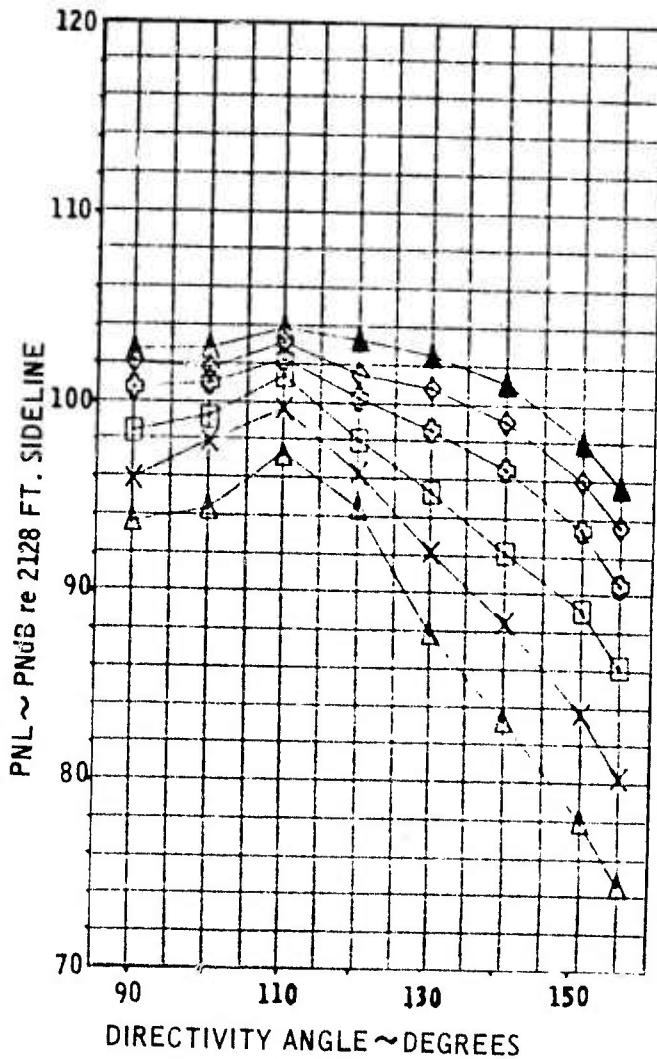


37T-3.3AR-CPA-ET/RC WITH 3.1AR EJECTOR



PEAK PNL SUPPRESSION VALUES

NOZZLE: 37T-3.3AR-CPA-ET/RC
WITH 3.1 AR EJECTOR

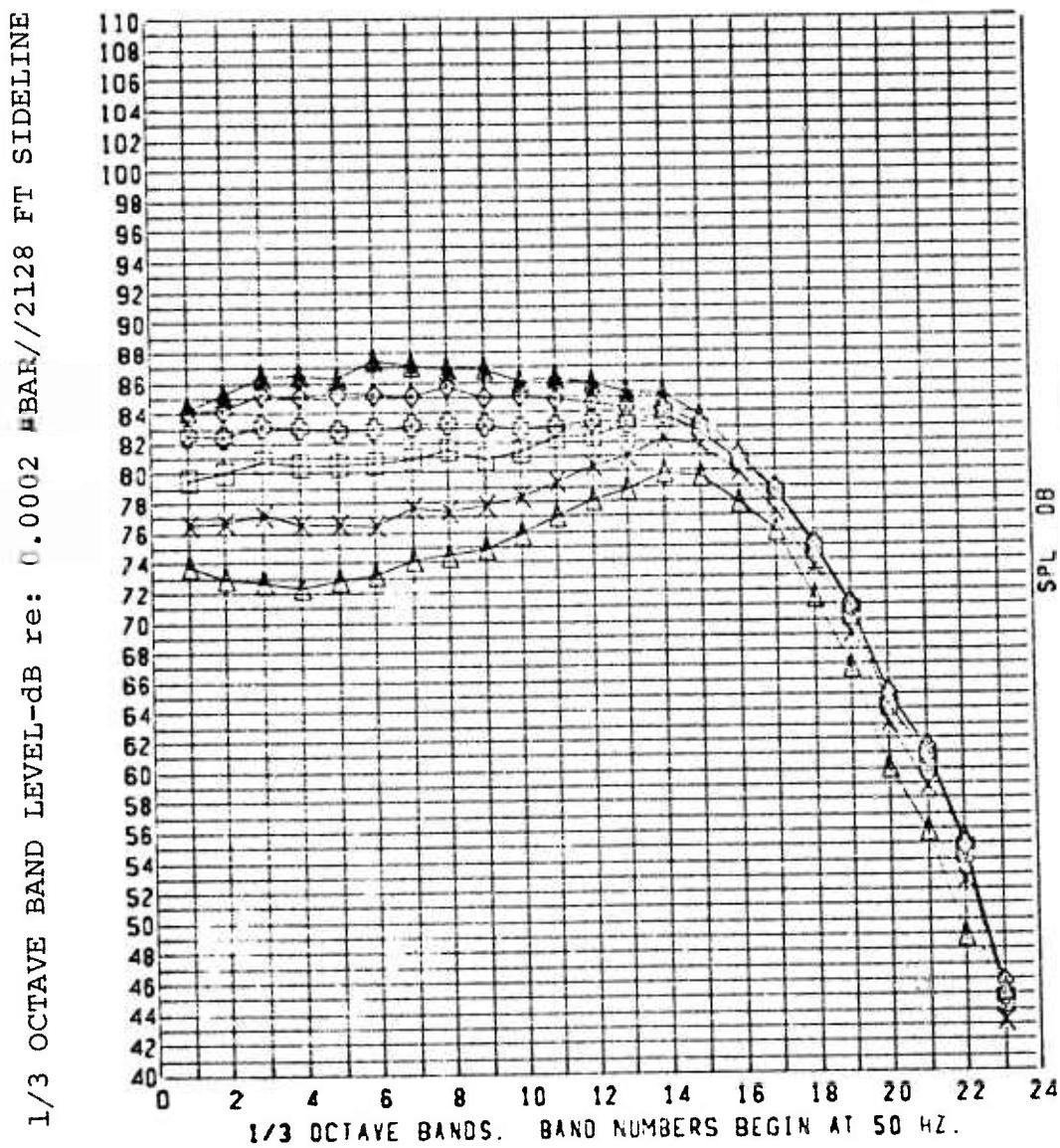


TT = 1150°F A₈ = 6.05 FT² RUN: 16
PR = △ 2.0, × 2.5, □ 3.0, + 3.4, ◇ 3.7 ▲ 4.0

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



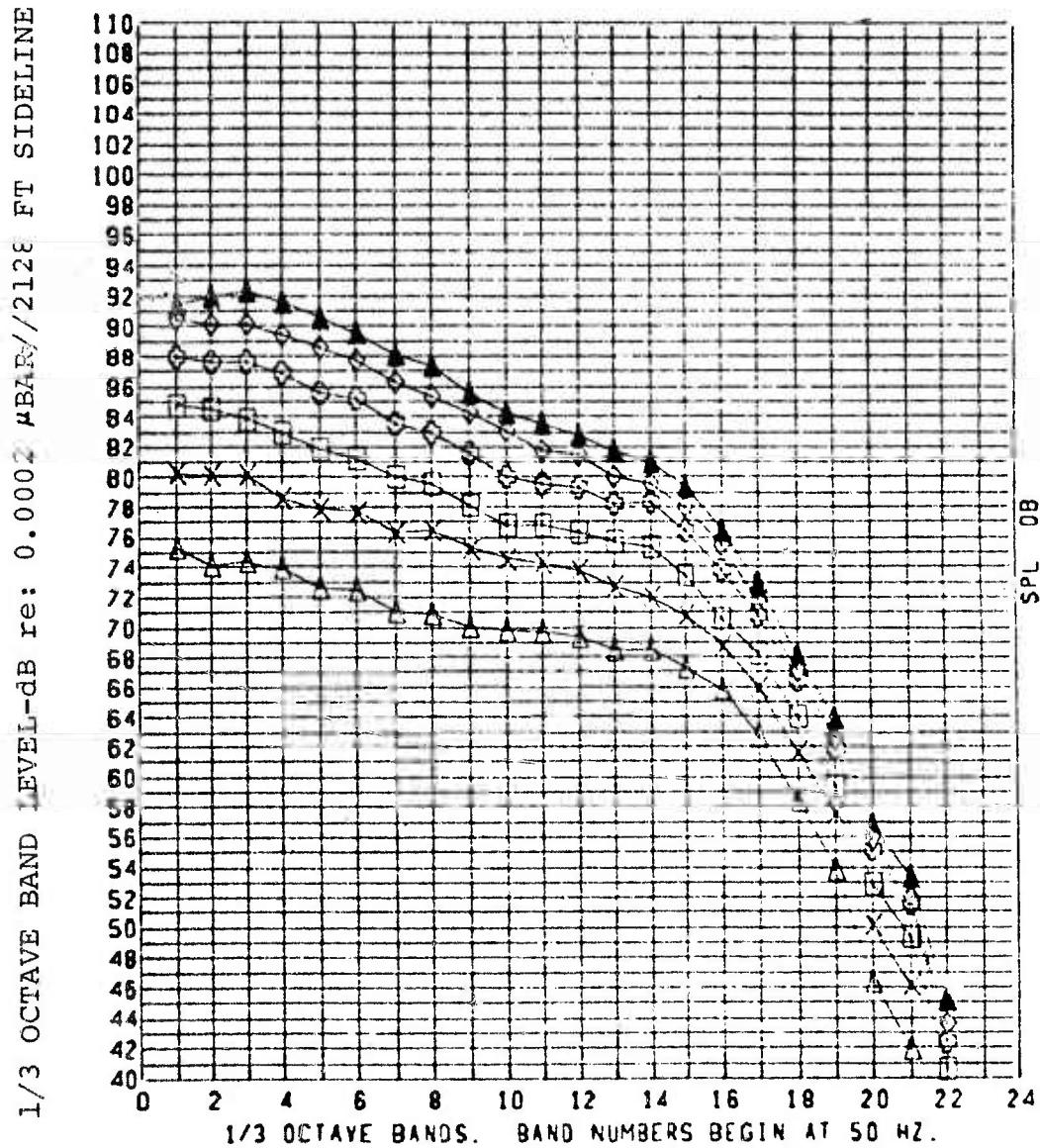
TT = 1150°F A8 = 6.05 FT² RUN: 16

PR = Δ 2.0, X 2.5, □ 3.0, + 3.4, ◇ 3.7, ▲ 4.0

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°

re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TI = 1150°F A8 = 6.05 FT² RUN: 16
PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.4, \diamond 3.7, \blacktriangle

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE 130°
re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 37¹°-3.3AR-CPA-ET/RC
WITH 3.1AR EJECTOR BELLMOUTH, L/D=2

FACILITY: WALL ISOLATION FACILITY

DATE: January 4, 1974

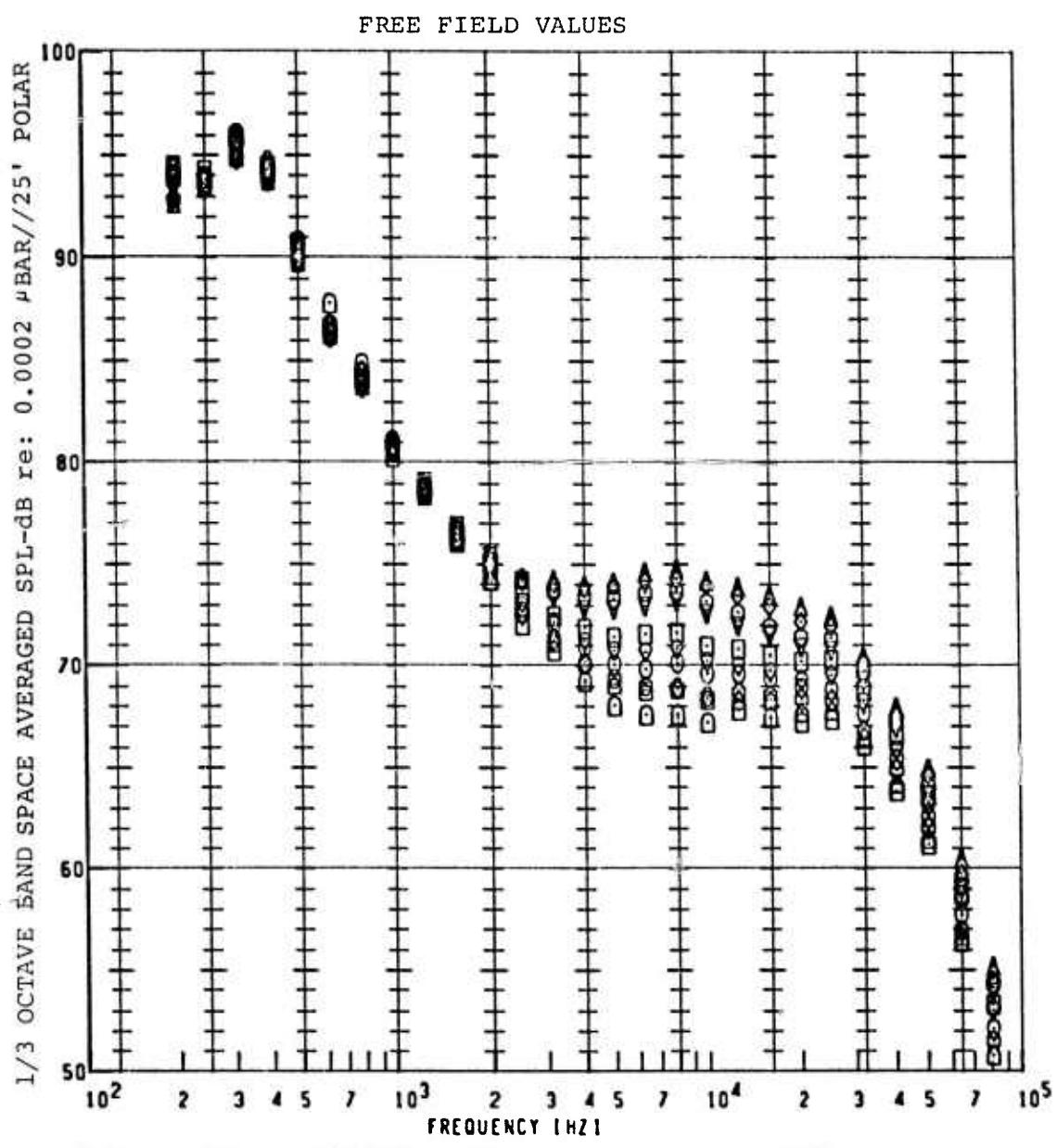
P_{AMB} = 29.83 in Hg **T_{AMB}** = 30°F **R.H.** = 56%

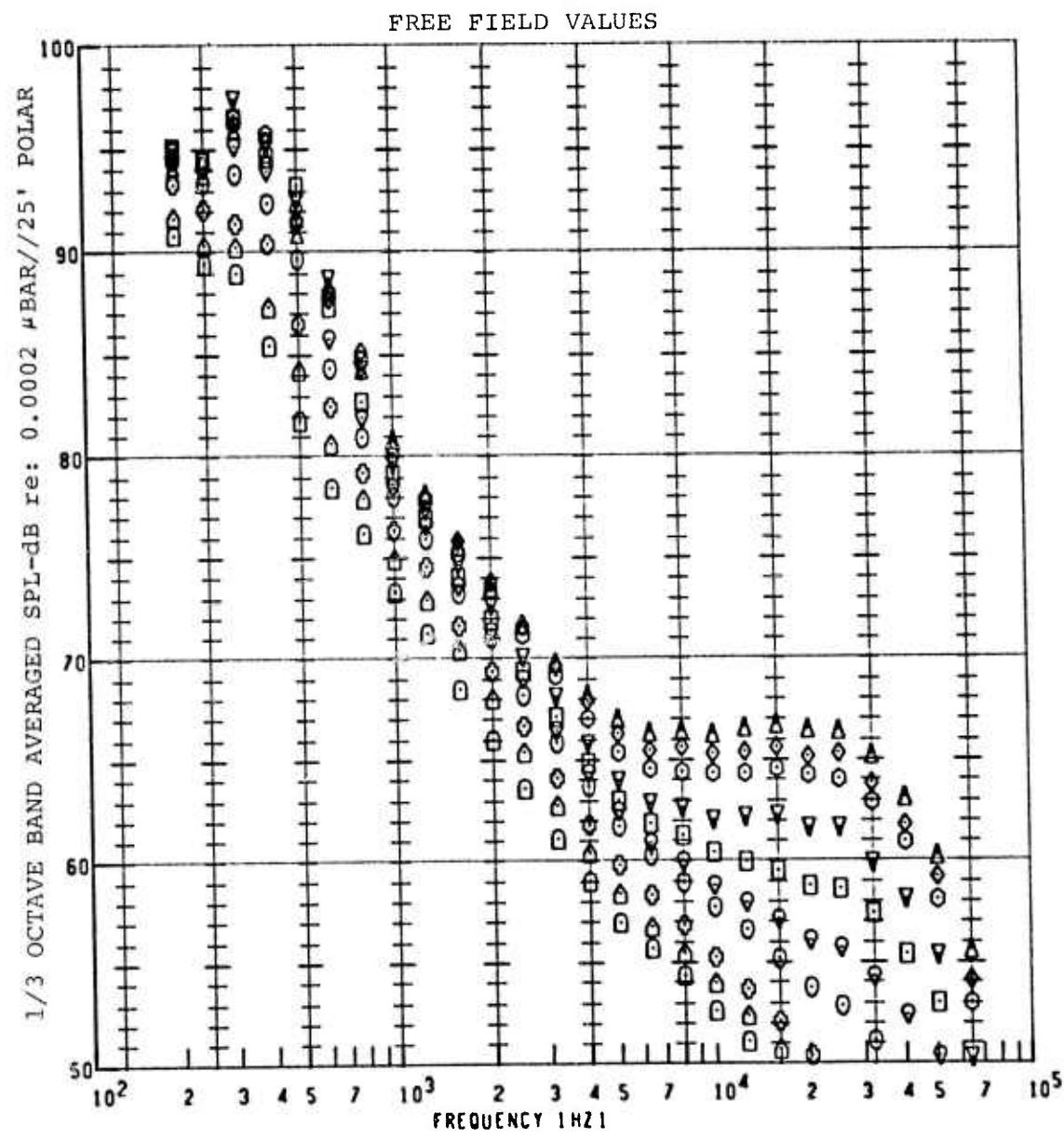
NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

SCALE MODEL A₈ = 13.6 in.²

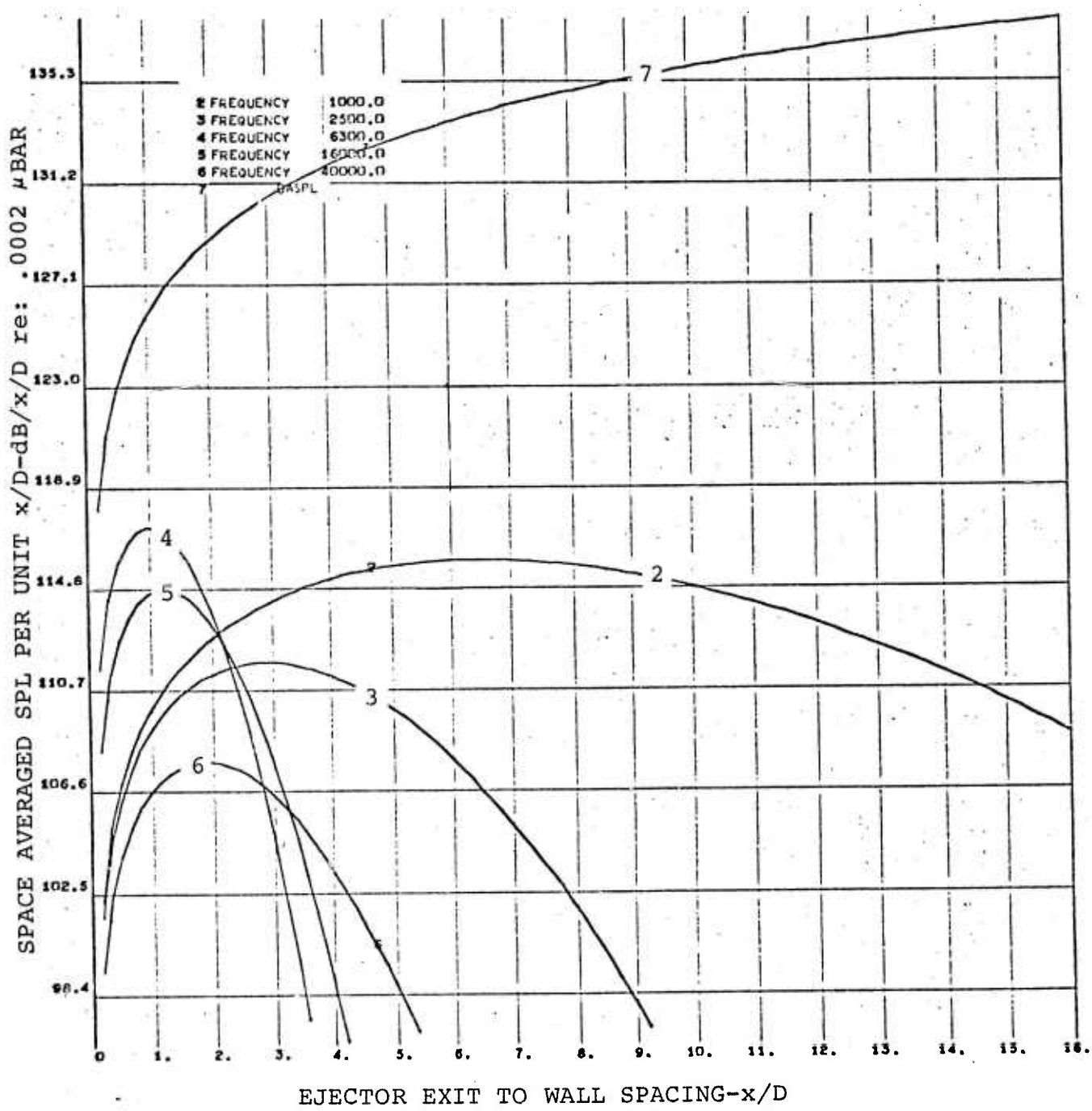
RUN NO.	AXIAL LOCATION	IRIS DIA.	REMARKS	REF.
377	0.0 x/D*	9.4 in.	*x/D is relative to ejector exit plane	
380	0.25	9.6		
383	0.50	9.8		
386	0.75	10.0		
389	1.00	10.4		
392	1.25	10.6		
395	1.50	10.8		
398	1.75	11.2		
401	2.0	13.6		
404	2.5	13.0		
407	3.0	13.4		
410	3.5	14.4		
413	4.0	15.4		
416	5.0	14.4		
419	6.0	15.6		
422	7.0	16.4		
425	8.0	17.8		
428	10.0	19.8		
	12.0			
431	14.0	22.0		
434		24.0		

MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC





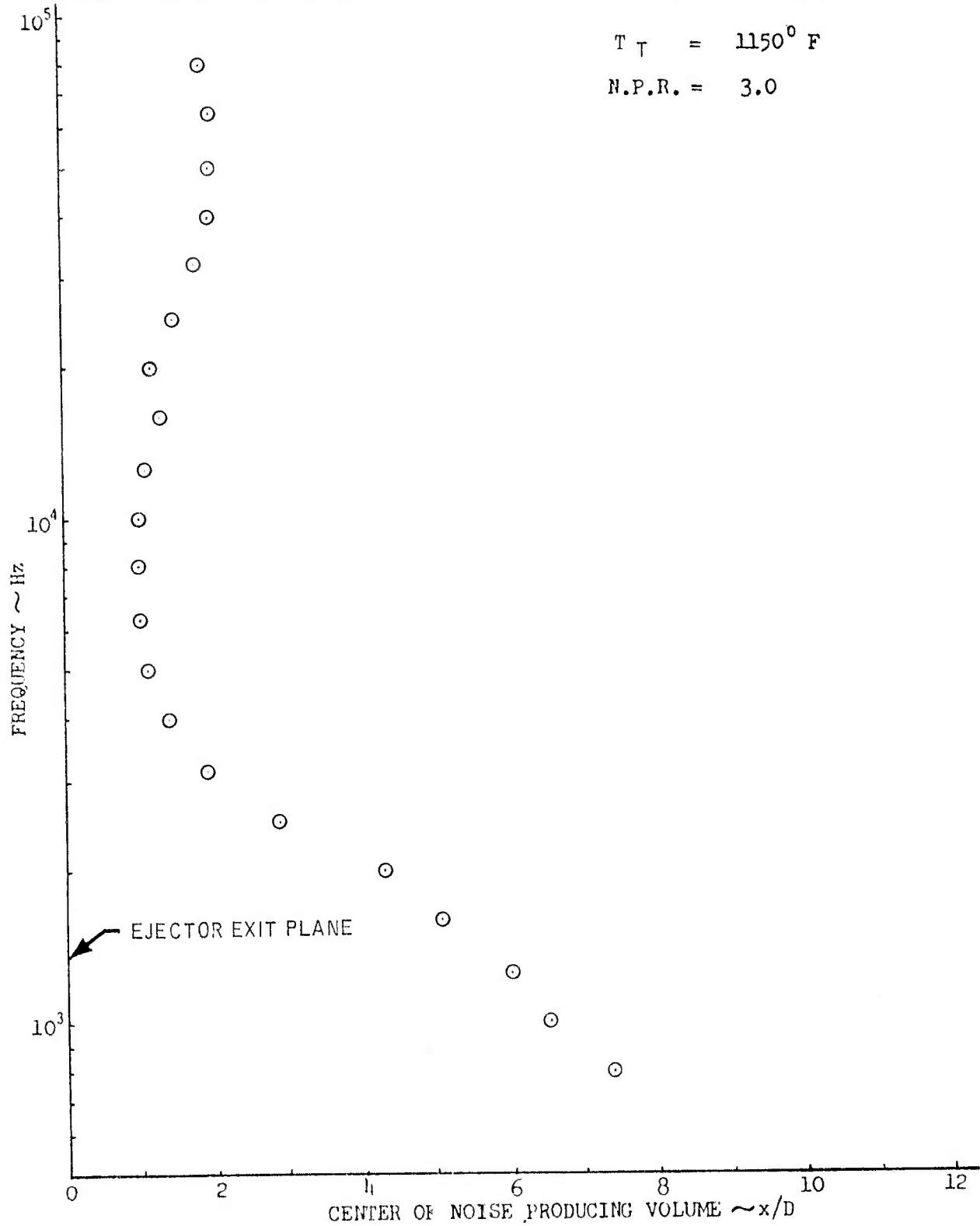
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	407	3.00	1150°F
◇	410	3.00	1150
○	413	3.00	1150
▽	416	3.00	1150
□	419	3.00	1150
◆	422	3.00	1150
○	425	3.00	1150
○	428	3.00	1150
△	431	3.00	1150
□	434	3.00	1150

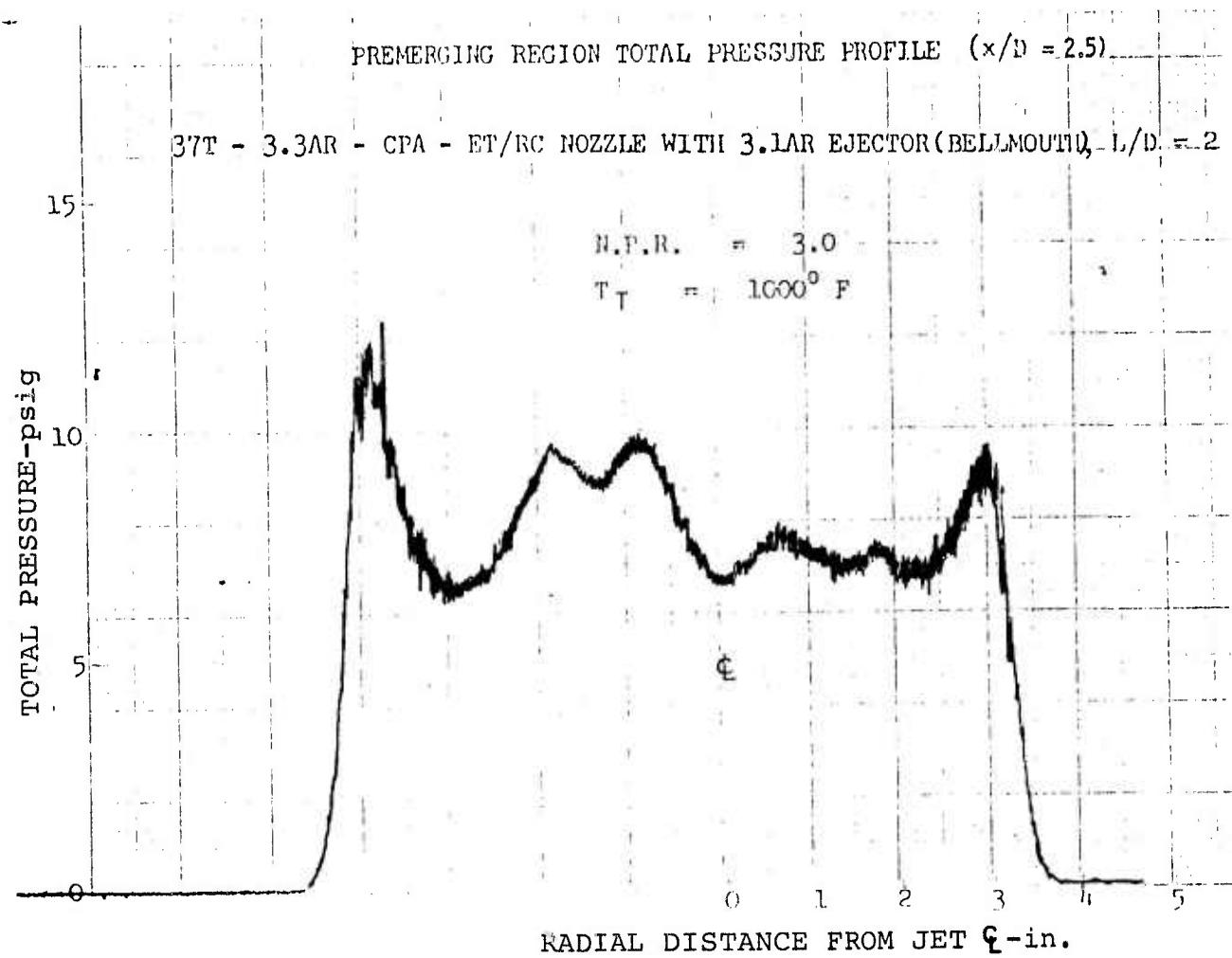


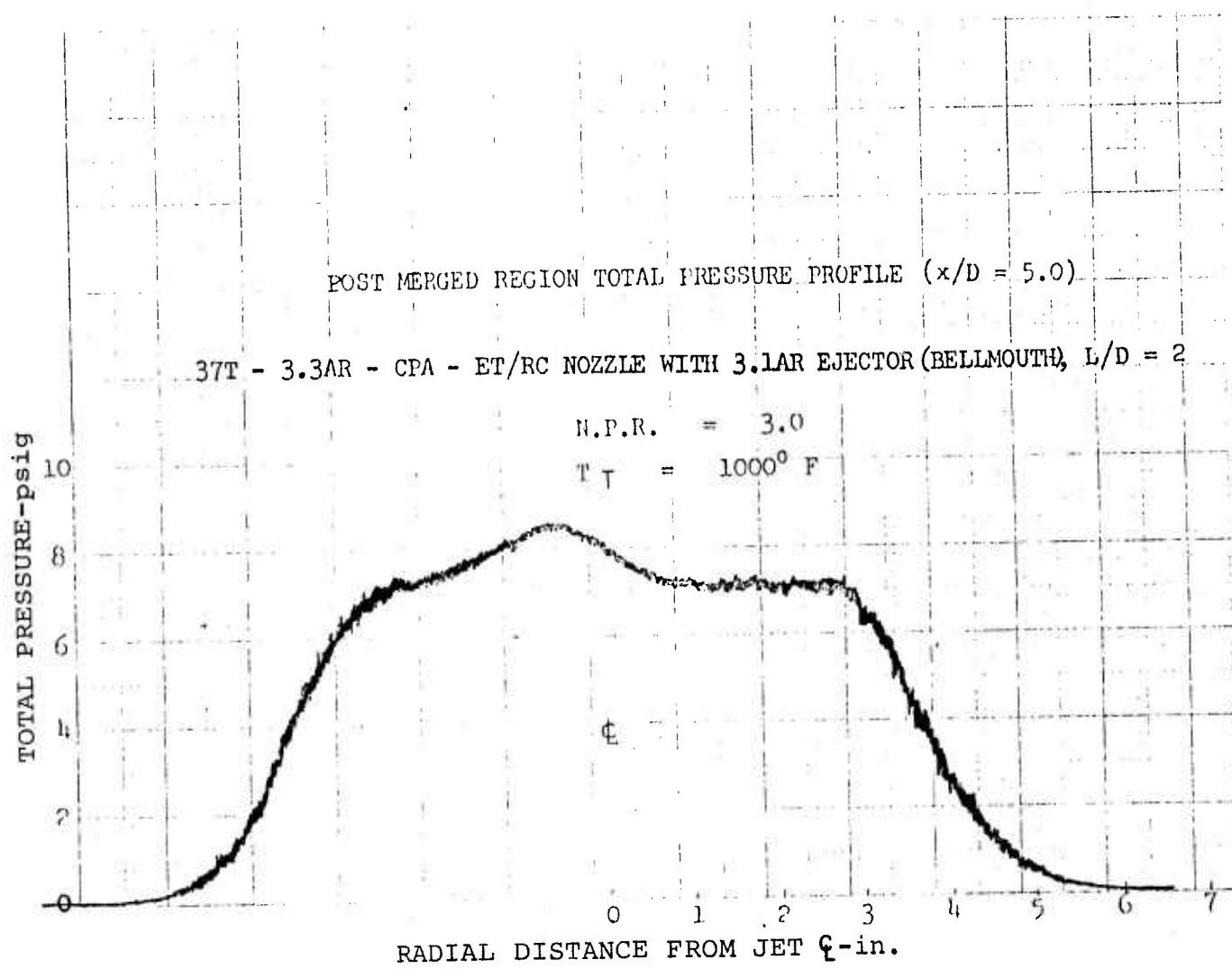
37T - 3.3AR - CPA - ET/RC NOZZLE WITH 3.1AR EJECTOR BELLMOUTH, L/D = 2

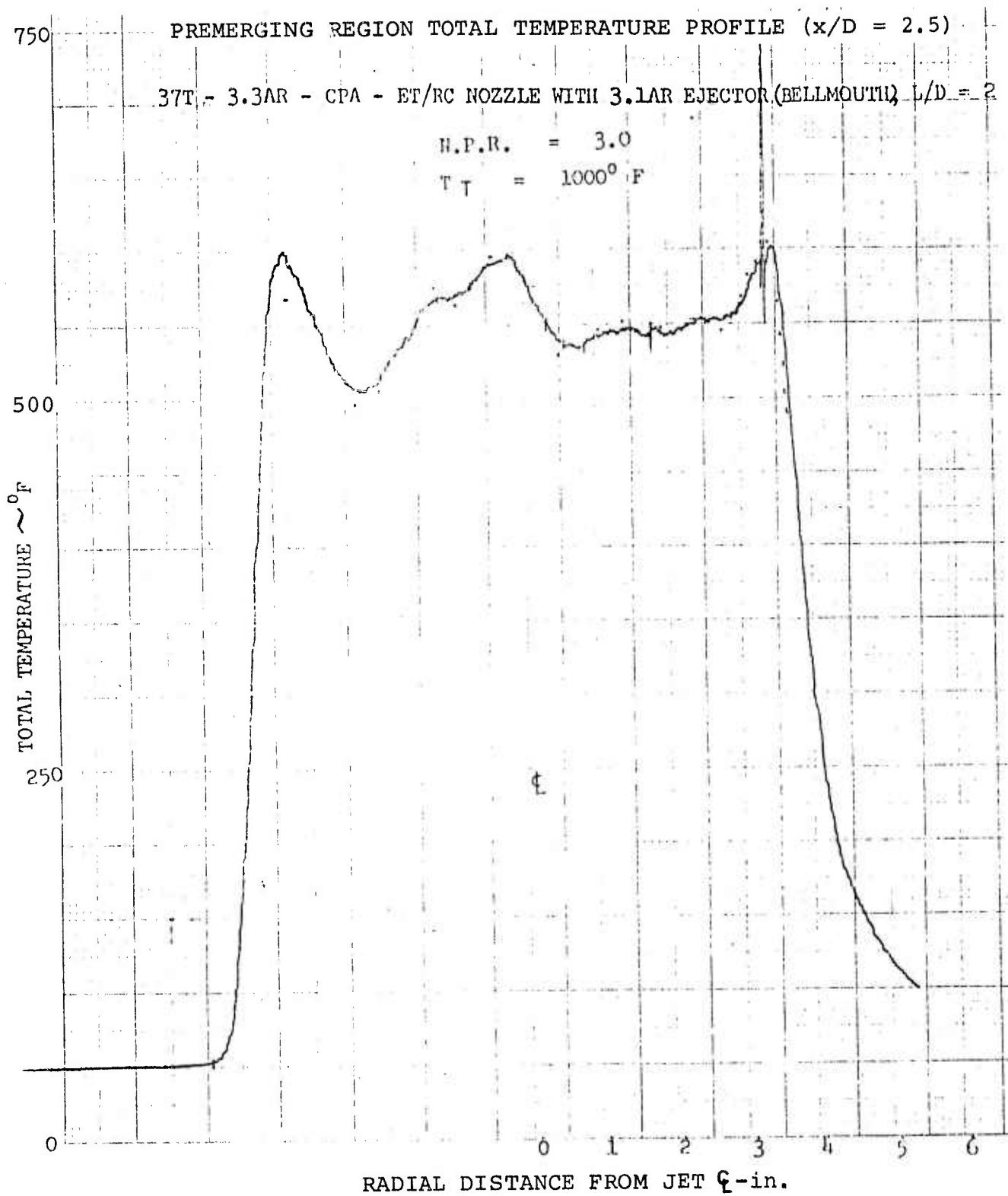
T_T = 1150° F

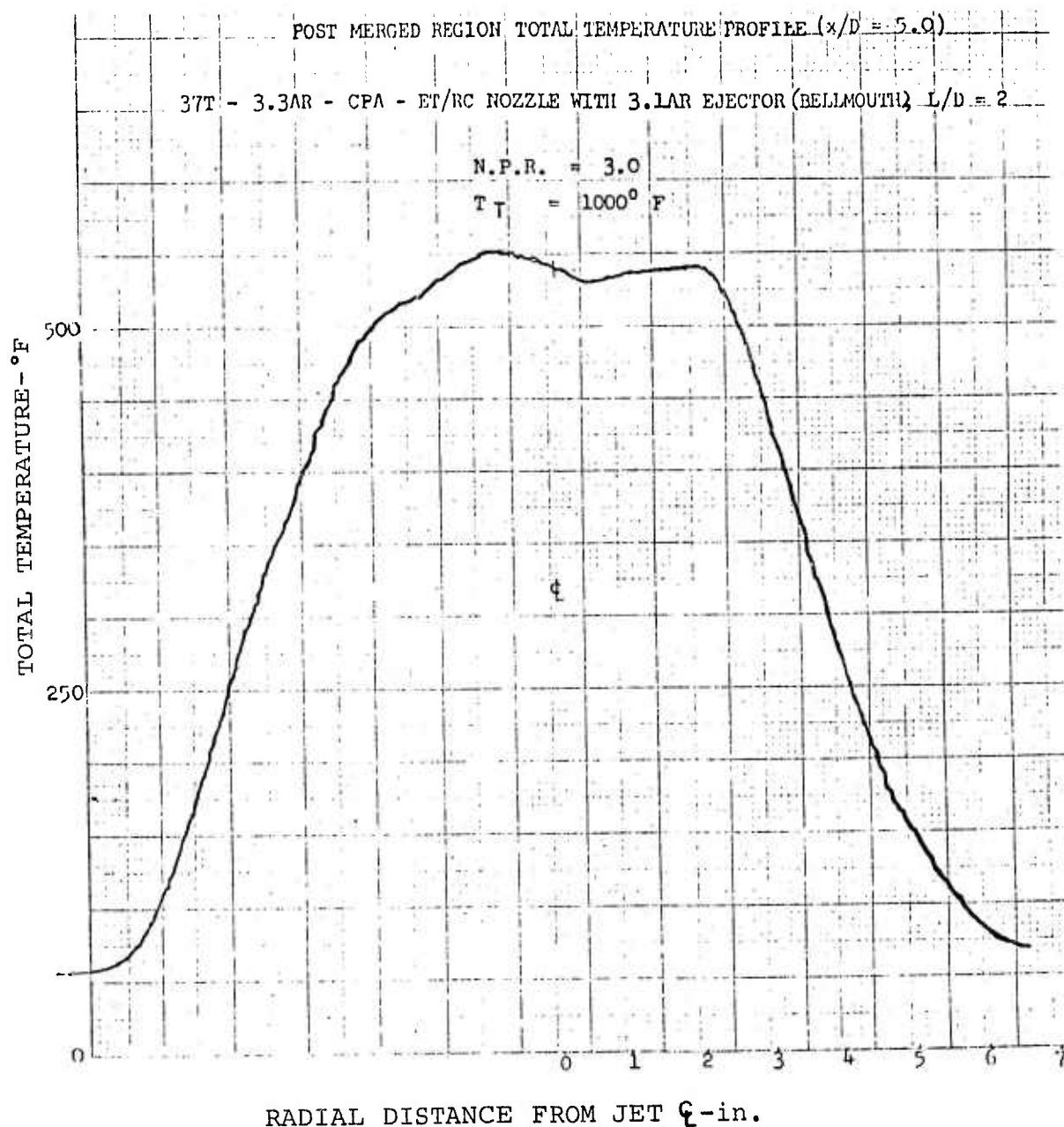
N.P.R. = 3.0



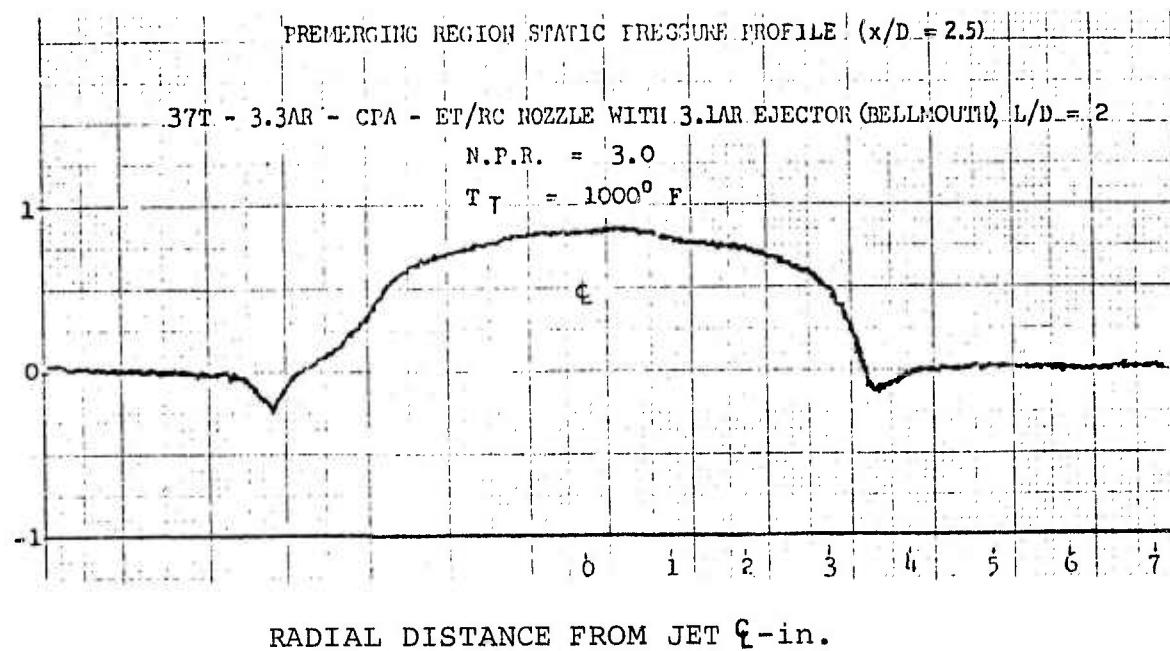


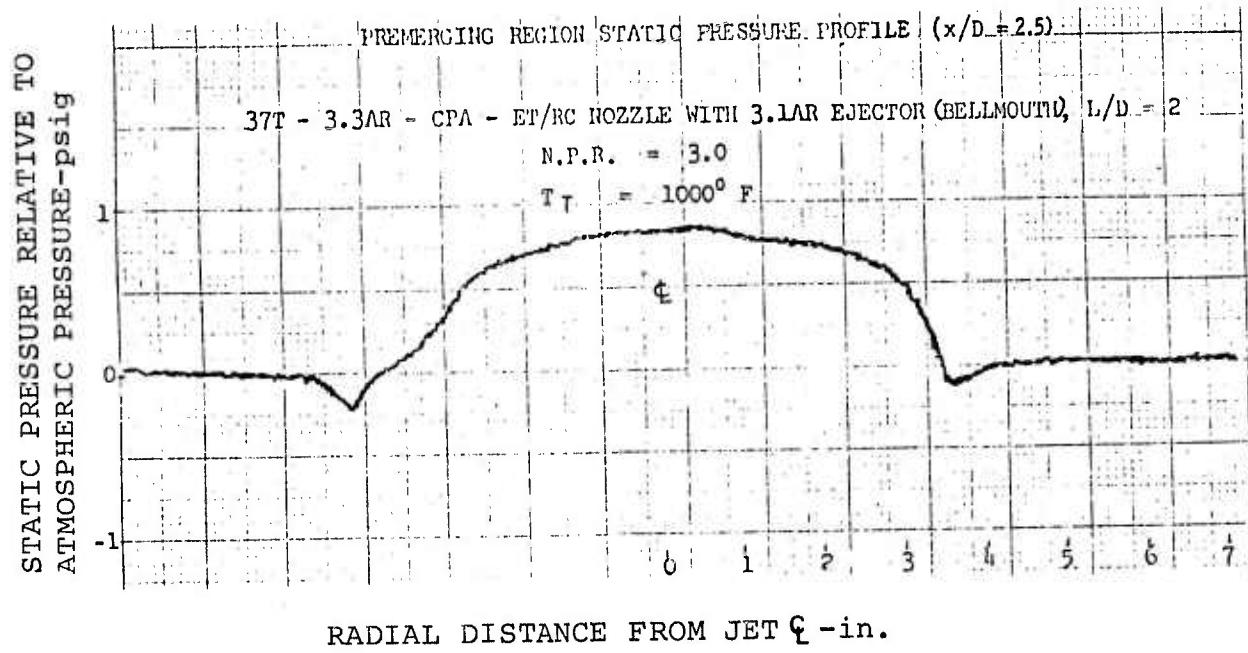




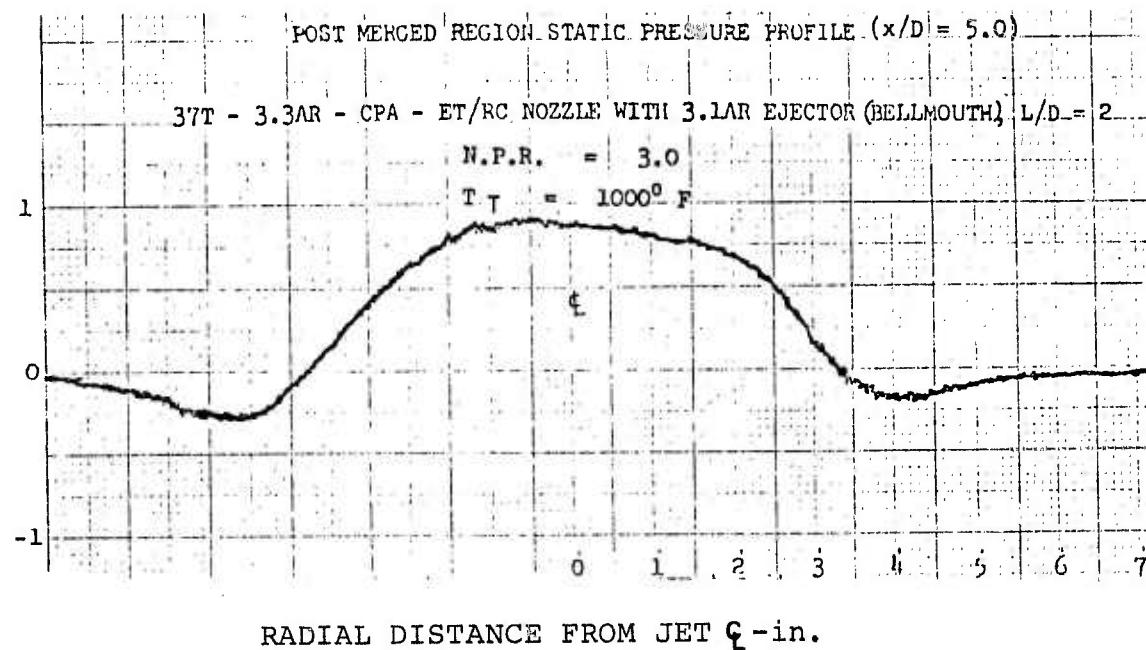


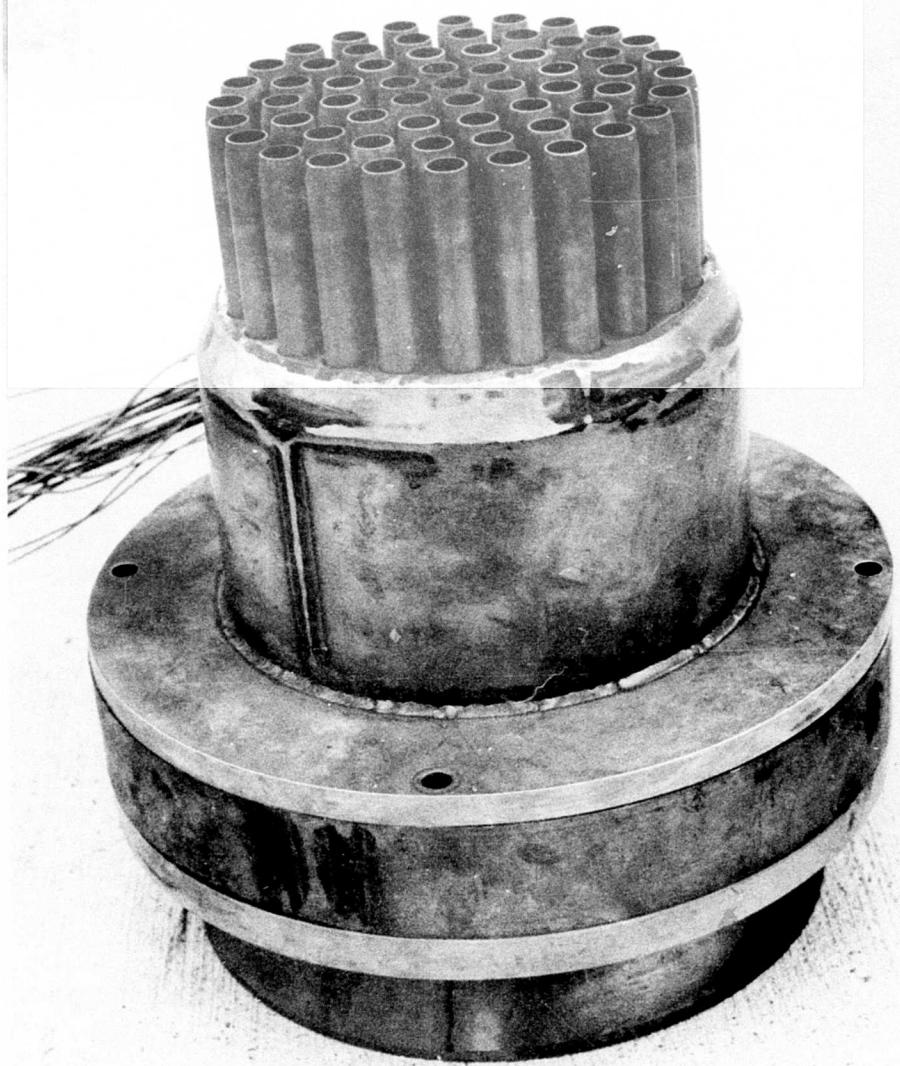
STATIC PRESSURE RELATIVE TO
ATMOSPHERIC PRESSURE-psig



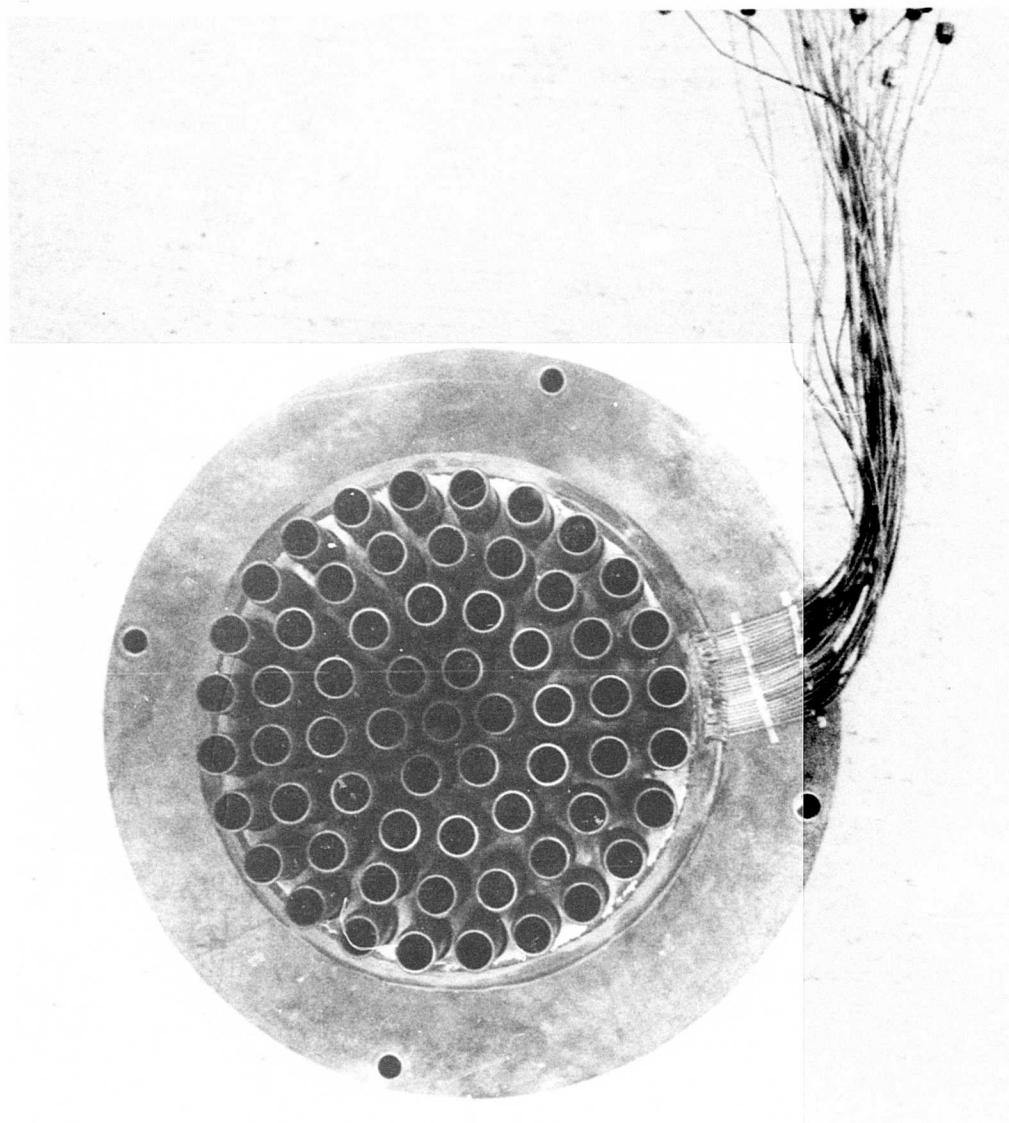


STATIC PRESSURE RELATIVE TO
ATMOSPHERIC PRESSURE-psig

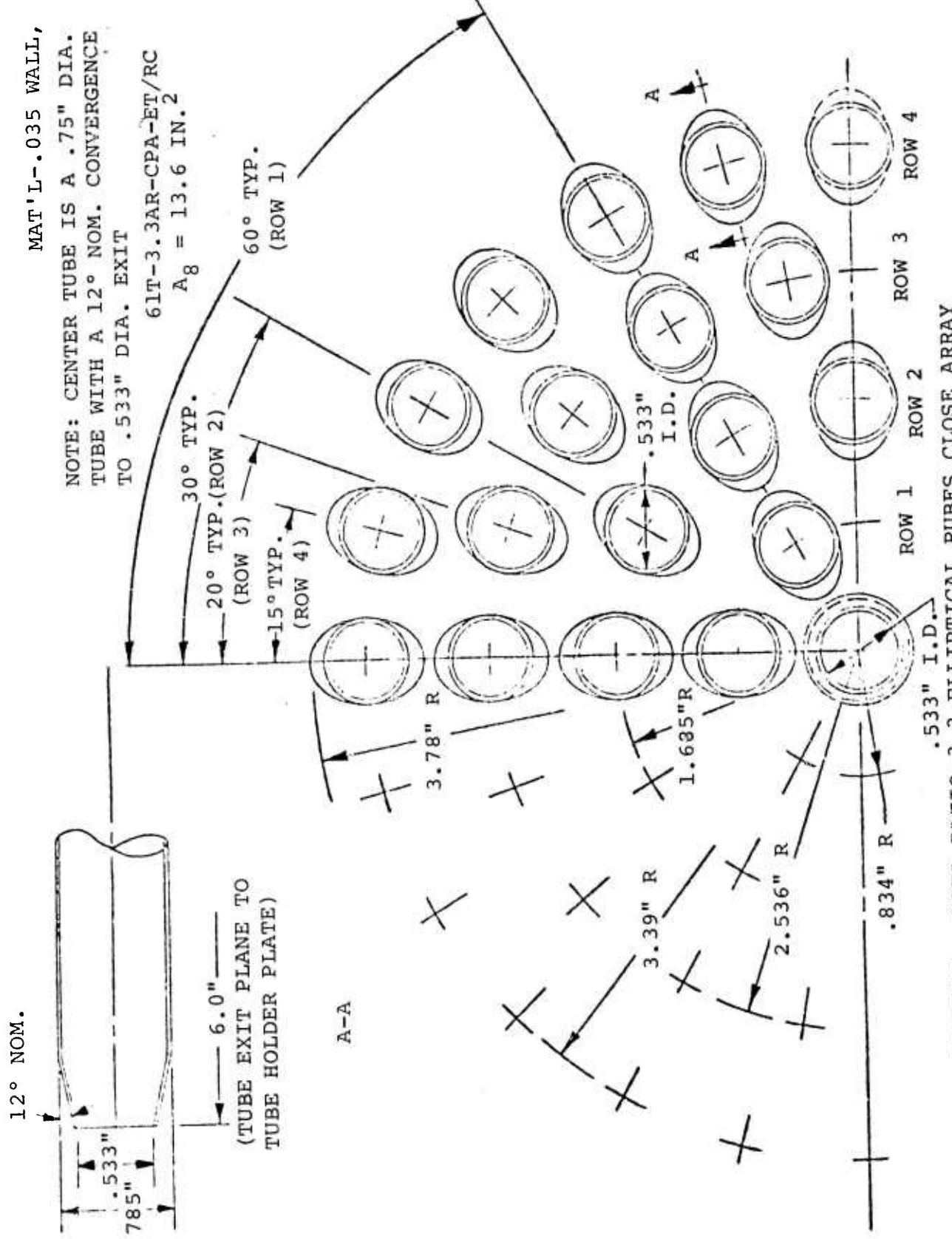




61T-3.3AR-CPA-ET/RC NOZZLE



61T-3.3AR-CPA-ET/RC NOZZLE



TEST CONDITIONS

NOZZLE: 61T-3.3AR-CPA-ET/RC

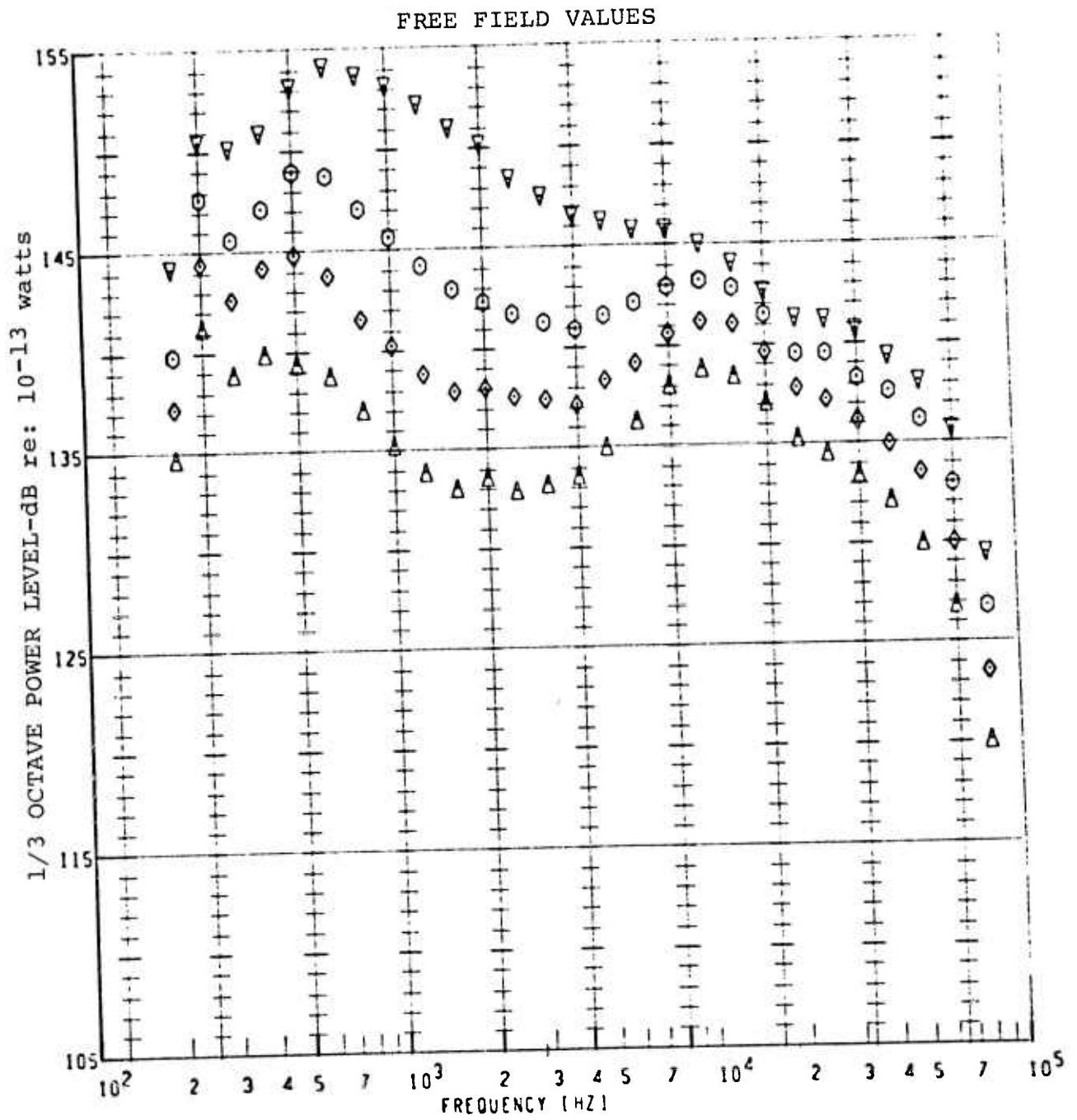
FACILITY: HNTF

DATE: 1-31-73 **T_{AMB}** = 48.5°F **R.H.** = 68%

SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
239	2.0	1150°F	1875 fps	3" tube lengths	
"	2.5	"	2126	" "	
"	3.0	"	2303	" "	
"	4.0	"	2544	" "	

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

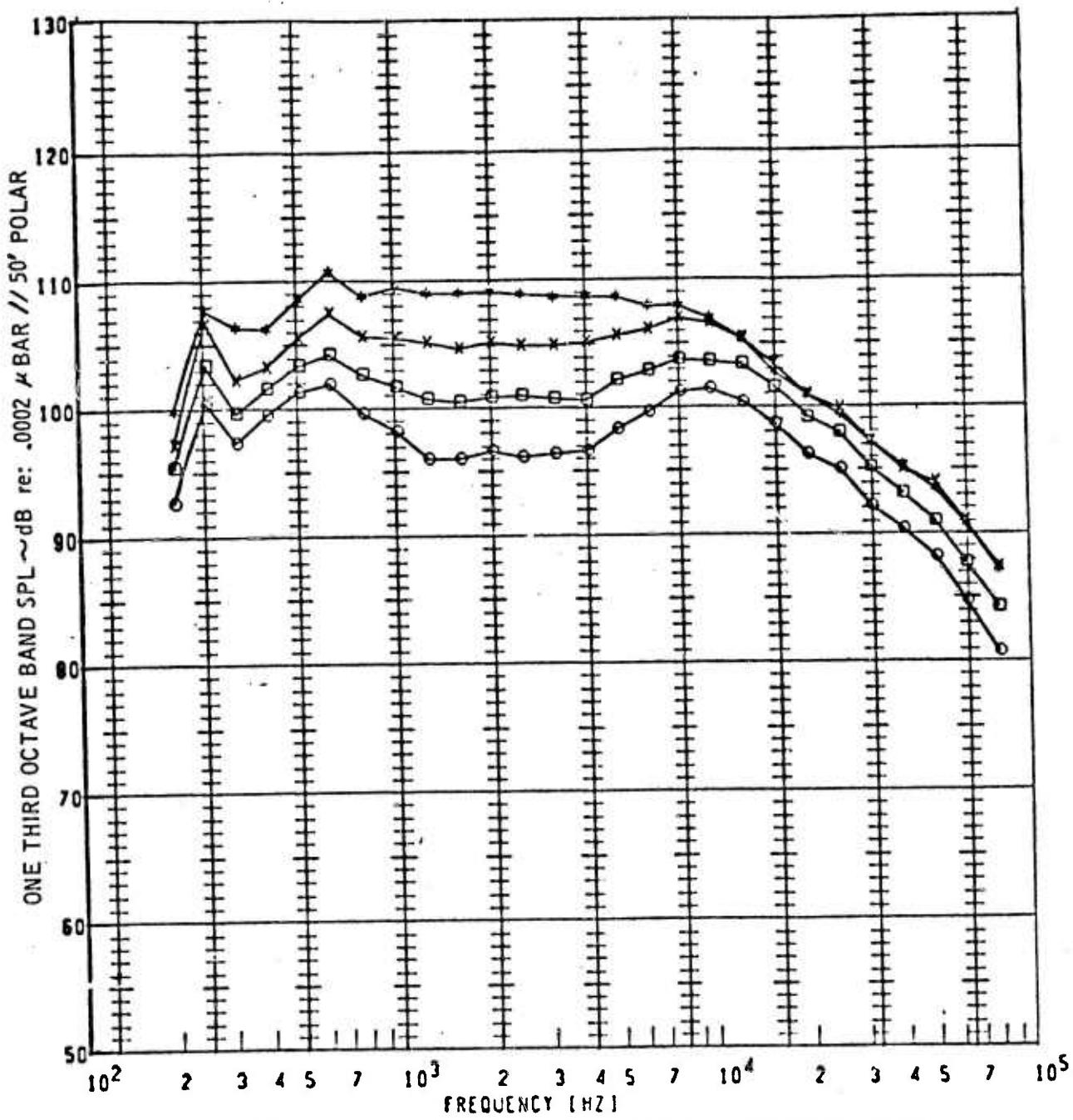


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
Δ	239	2.00	1150°F
◊	239	2.50	1150
○	239	3.00	1150
▽	239	4.00	1150

NOZZLE: 61T-3.3AR-CPA-ET/RC

JET NOISE POWER SPECTRA

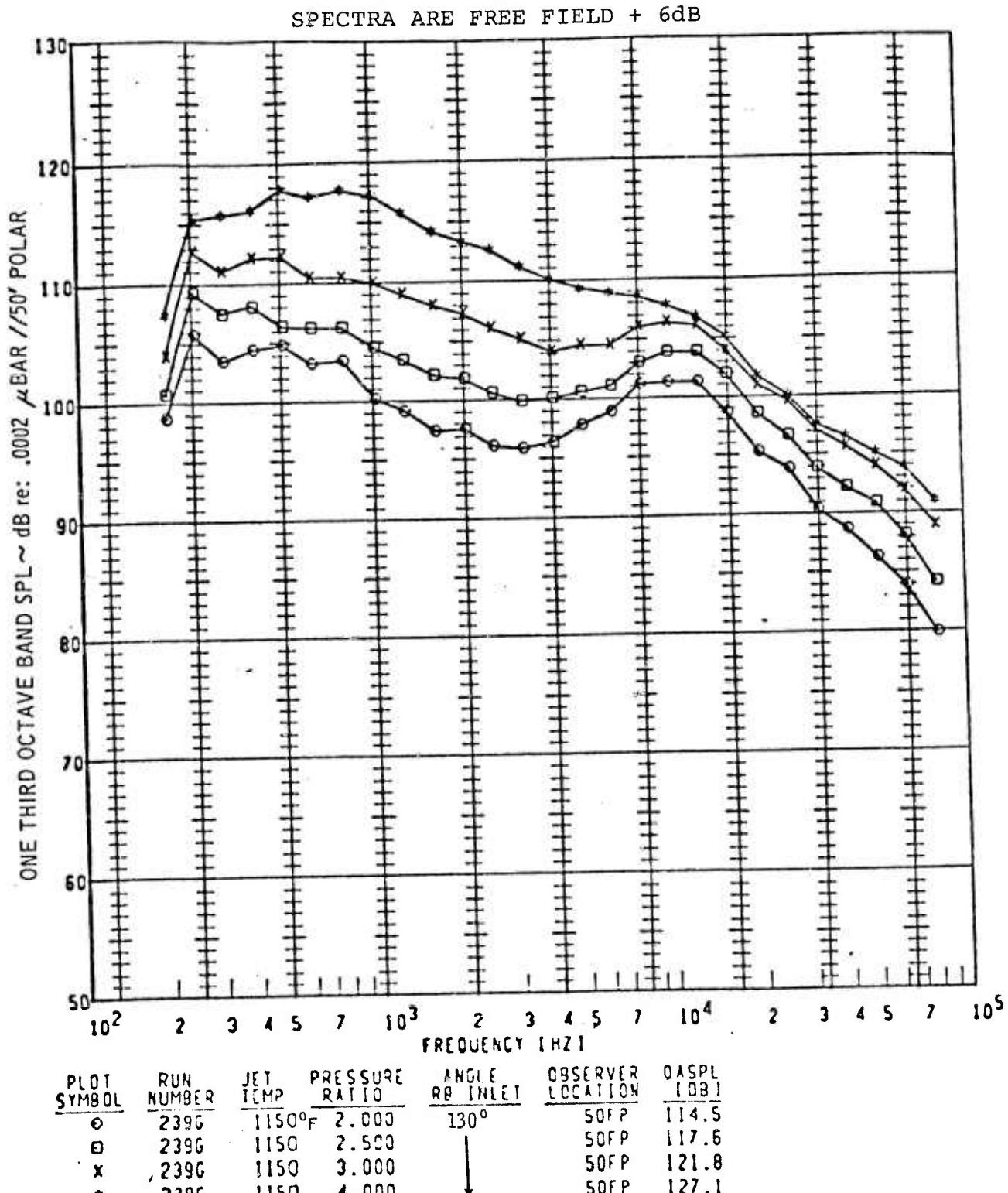
SPECTRA ARE FREE FIELD + 6dB



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL 1091
○	239G	1150°F	2.000	110°	SOFP	112.3
□	239G	1150	2.500		SOFP	115.3
×	239G	1150	3.000		SOFP	118.5
*	239G	1150	4.000		SOFP	121.1

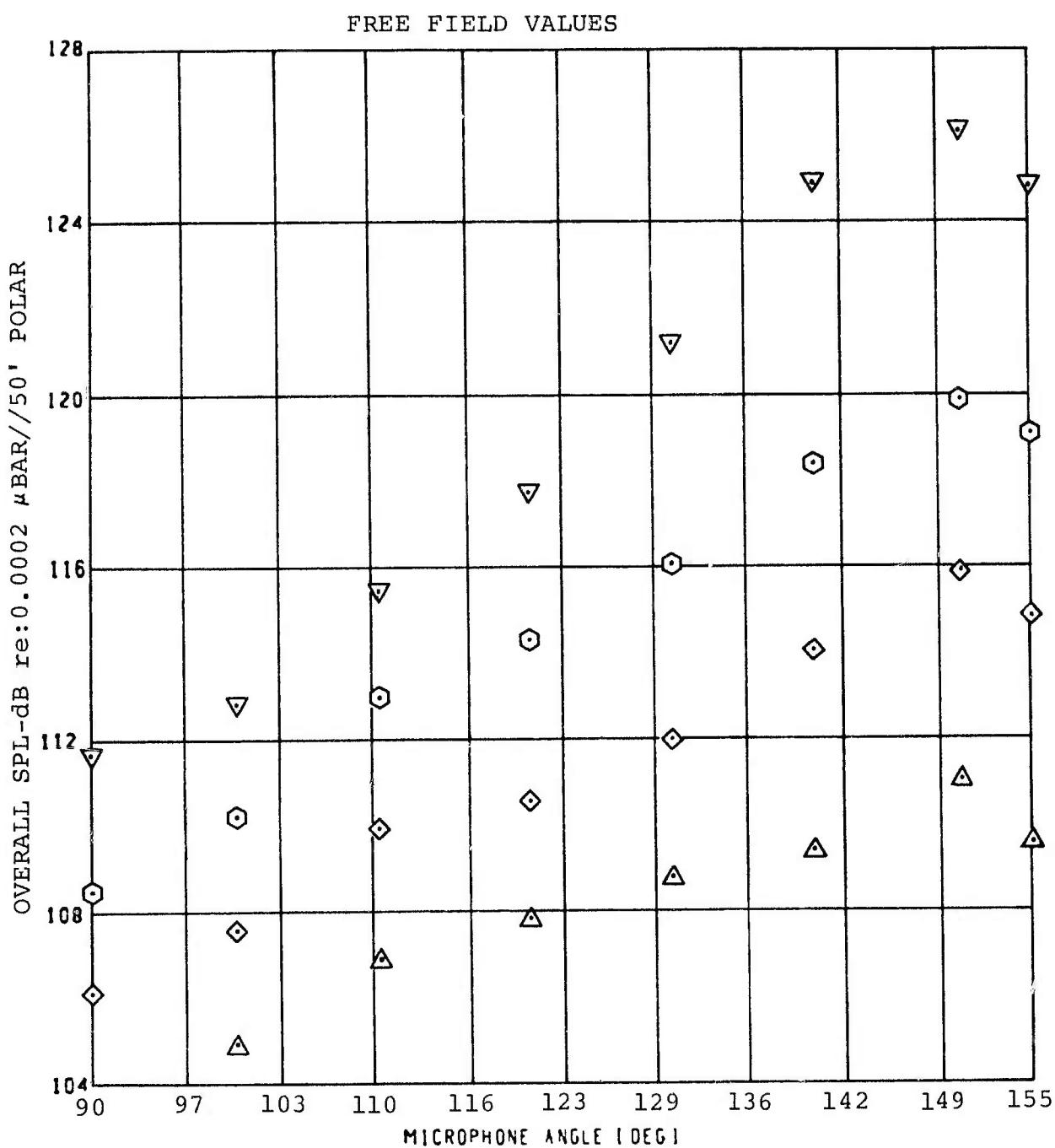
NOZZLE: .61T-3.3AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



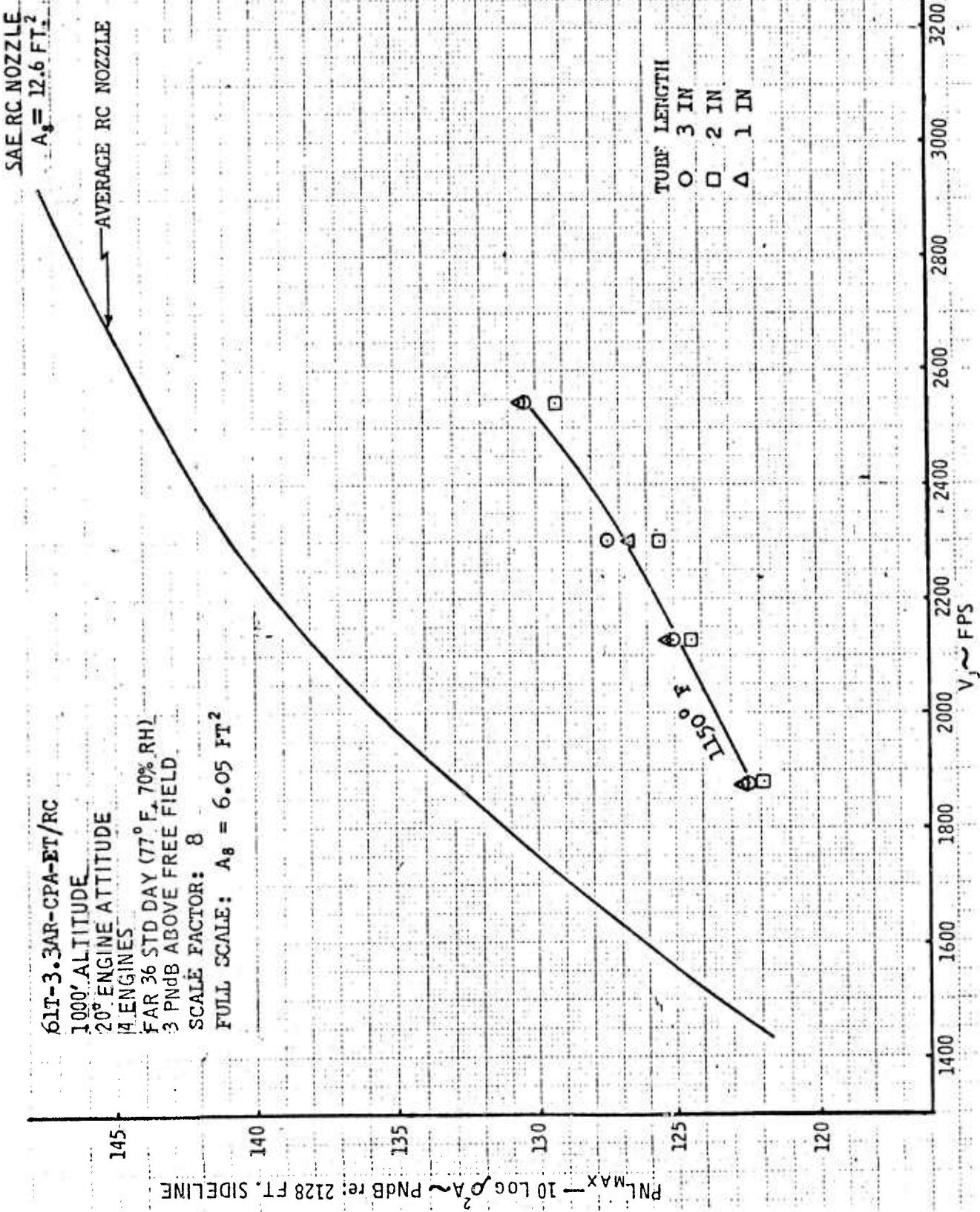
NOZZLE: 61T-3.3AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS

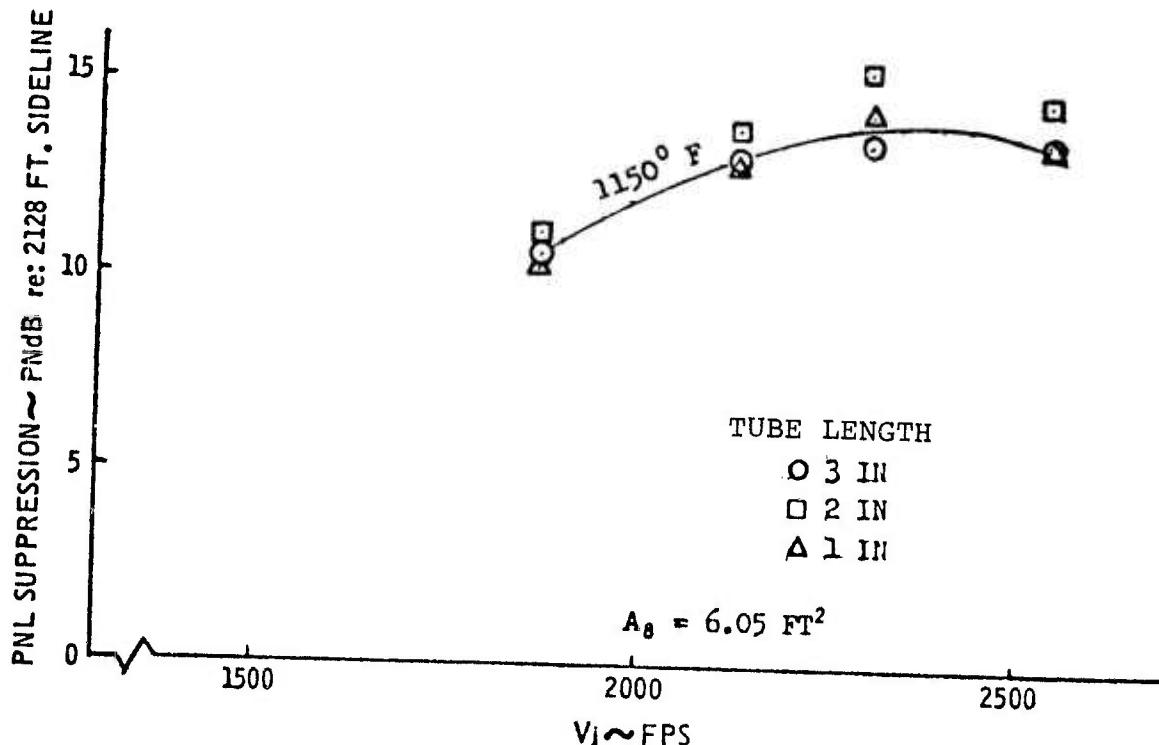


NOZZLE: 61T-3.3AR-CPA-ET/RC

OASPL BEAM PATTERNS

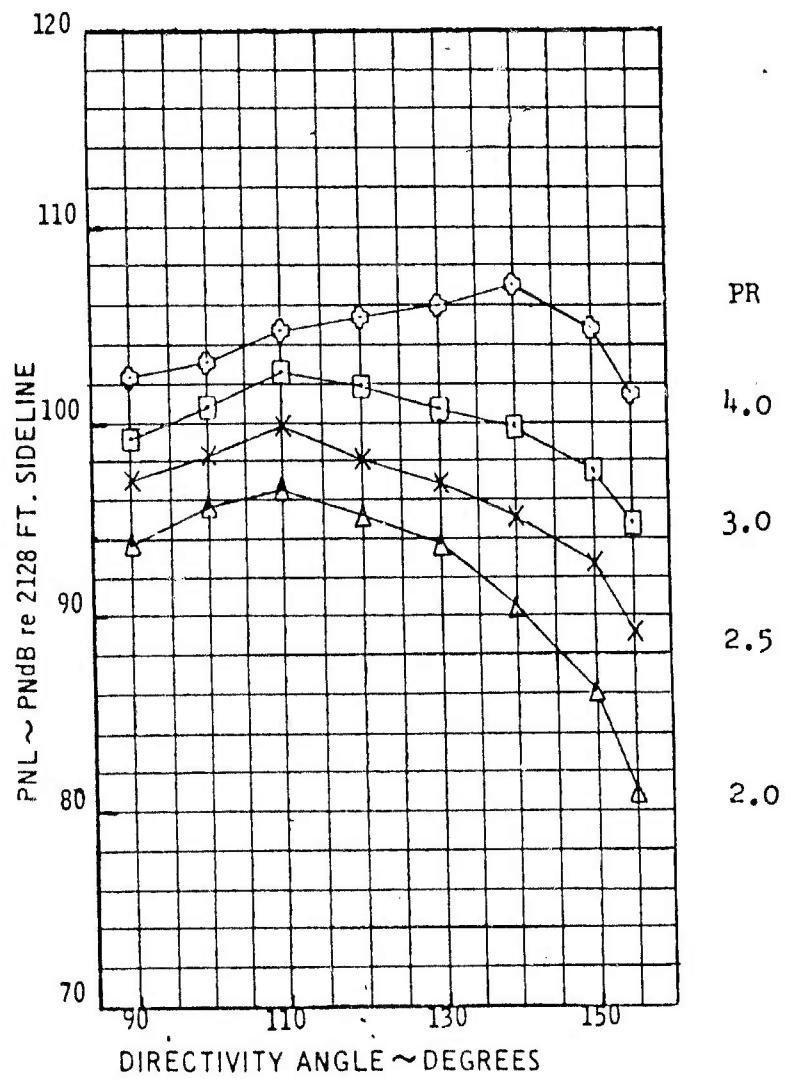


61T-3.3AR-CPA-ET/RC



PEAK PNL SUPPRESSION VALUES

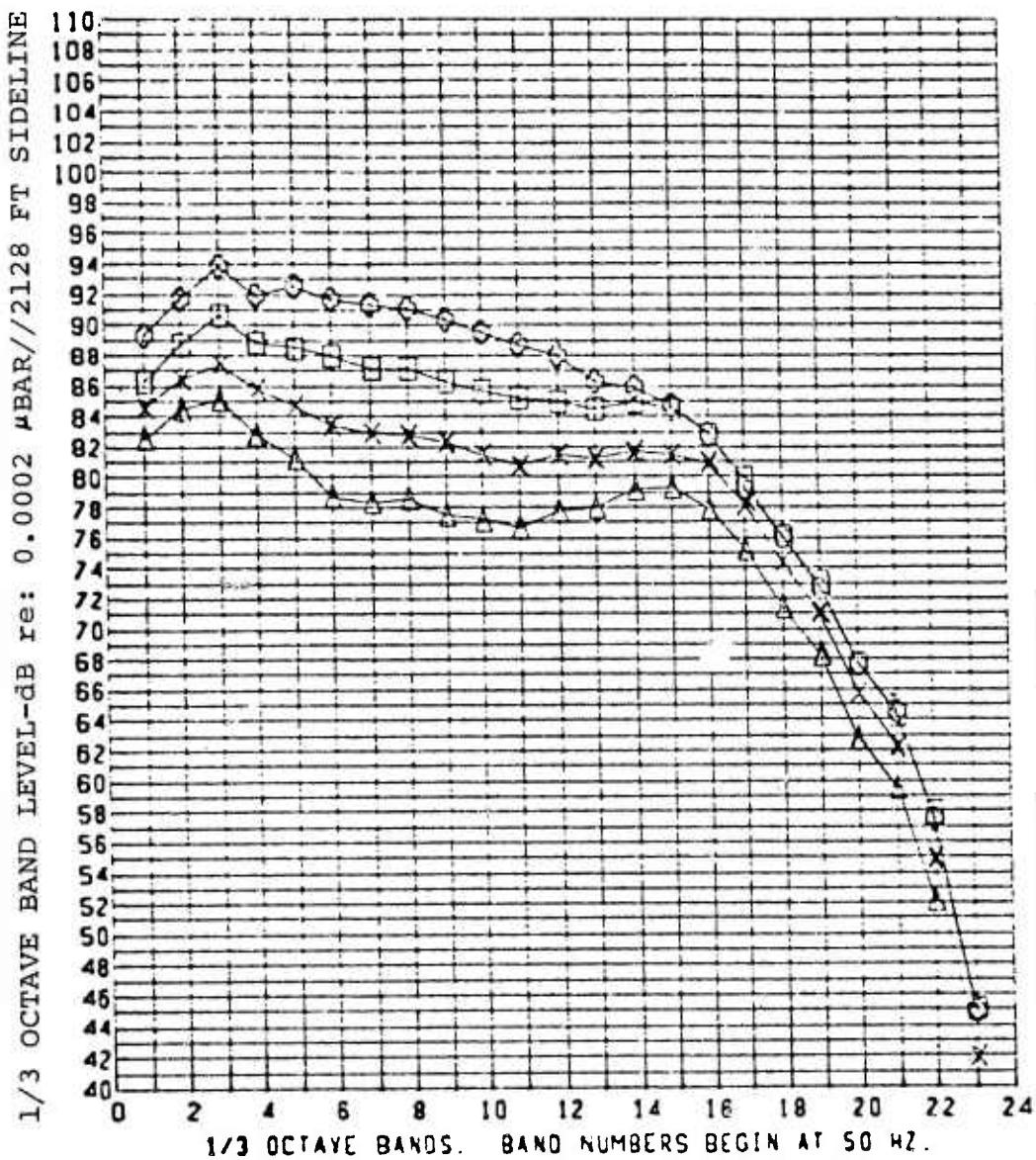
NOZZLE: 61T-3.3AR-CPA-ET/RC



RUN 239
TT = 1150° F A₈ = 6.05 FT²

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



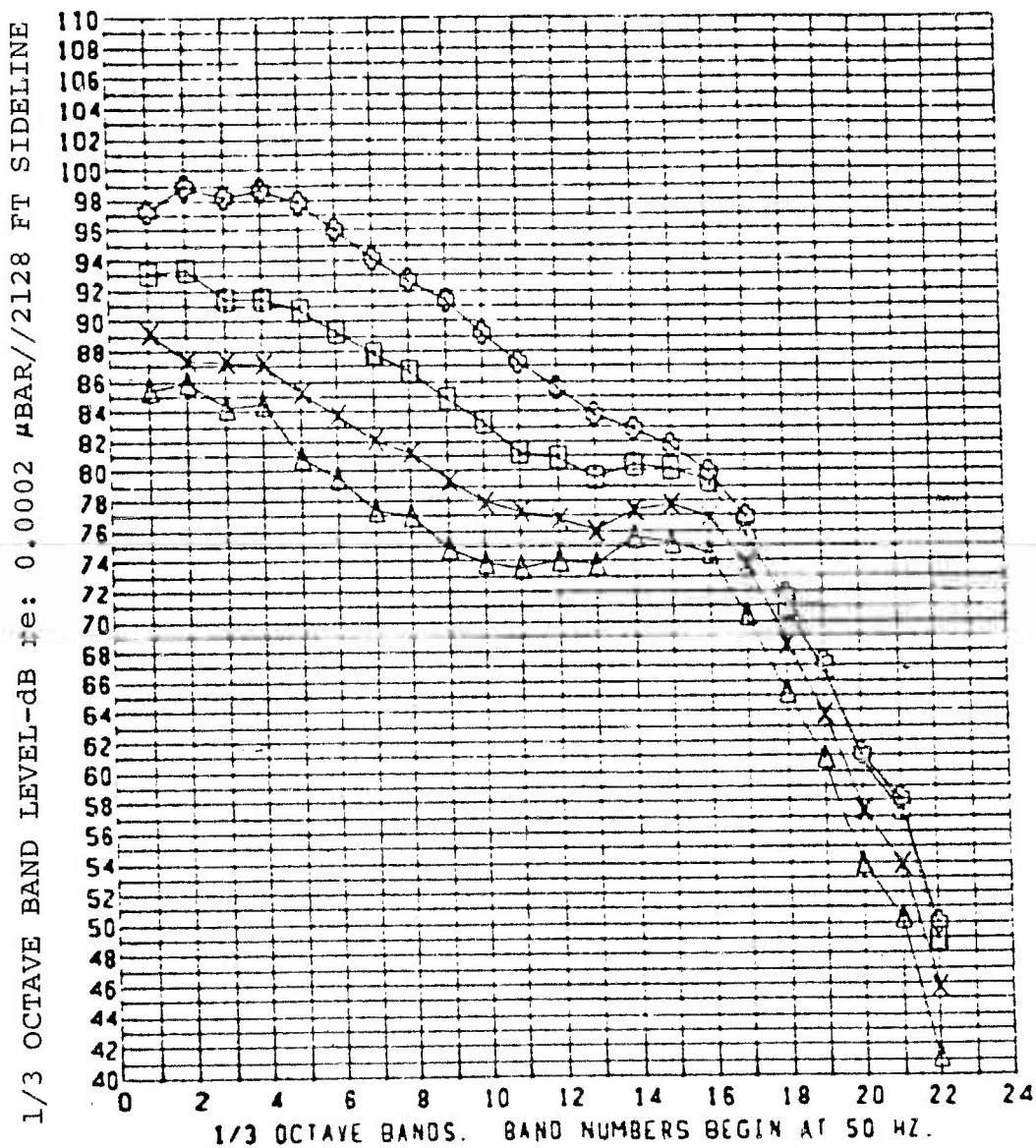
TT = 1150°F A8 = 6.05 FT² RUN: 239
PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 4.0

NOZZLE: 61T-3.3AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT.
SIDELINE, 110° re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 239

PR = Δ 2.0, X 2.5, □ 3.0, + 4.0

NOZZLE: 61T-3.3AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT.
SIDELINE, 130° re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 61T-3.3AR-CPA-ET/RC

FACILITY: WALL ISOLATION FACILITY

DATE: January 20, 1973

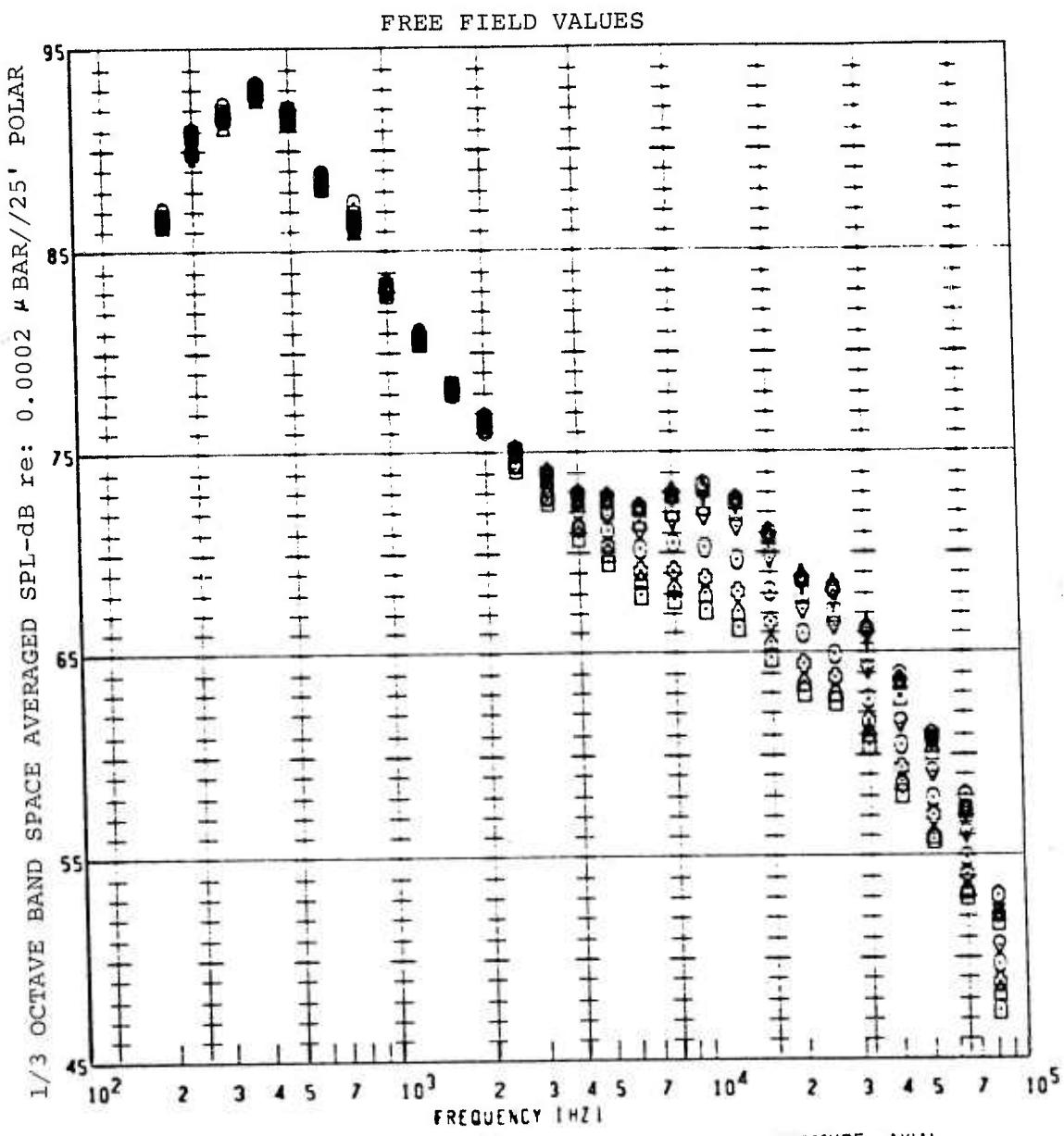
P_{AMB} = 30.06 in Hg **T_{AMB}** = 39°F **R.H.** = 92%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

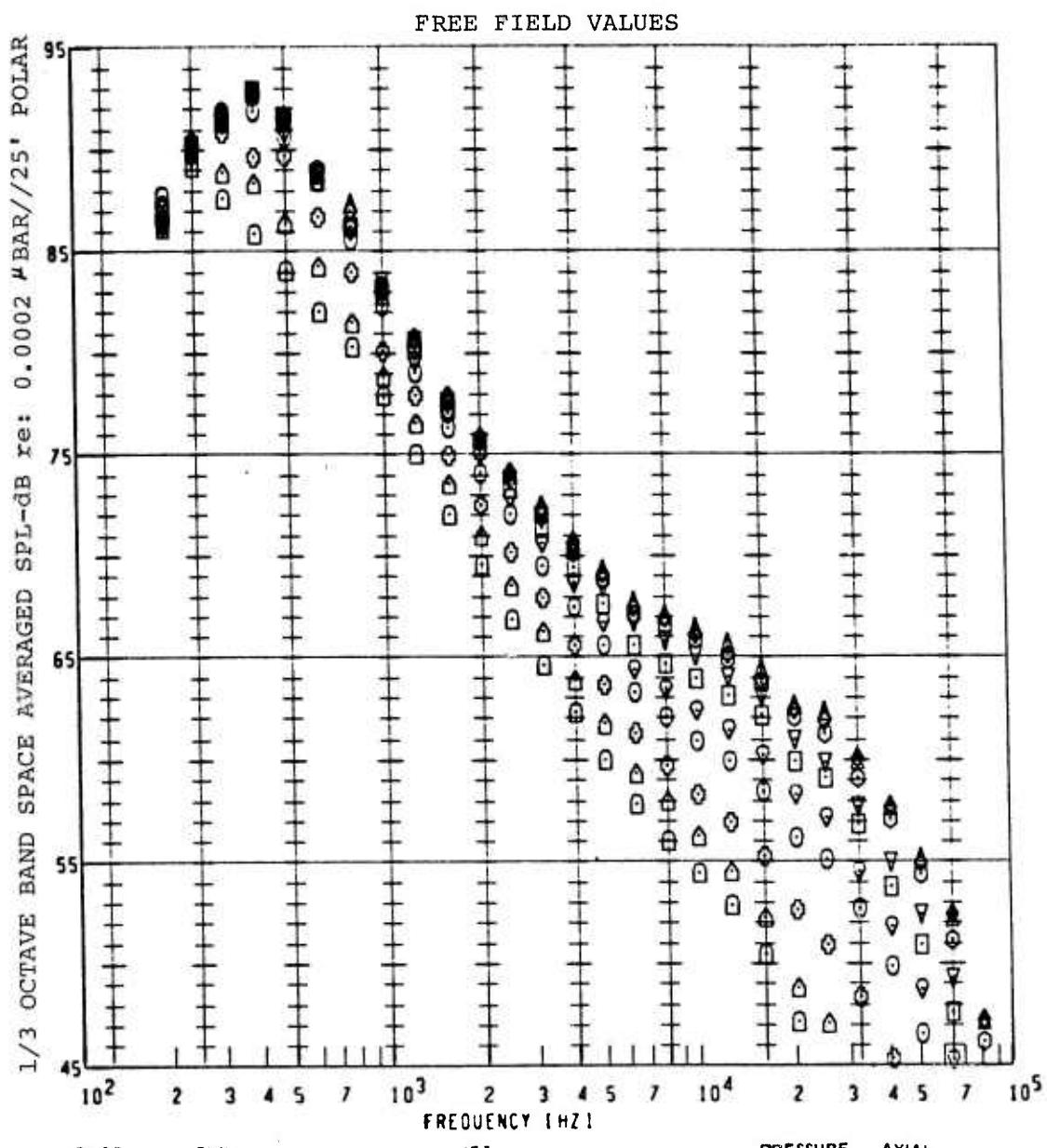
SCALE MODEL A₈ = 13.6 in.²

RUN NO.	AXIAL LOCATION	IRIS DIA.	REMARKS	REF.
124	0.0 x/D	9.0 in.		
125	0.25	9.0		
126	0.50	10.0		
127	0.75	10.0		
128	1.00	10.0		
129	1.25	10.5		
130	1.50	10.5		
131	1.75	11.0		
132	2.00	11.0		
133	2.25	11.5		
134	2.50	11.5		
135	2.75	12.0		
136	3.0	13.0		
137	3.5	14.0		
138	4.0	15.0		
139	5.0	16.0		
140	6.0	18.0		
141	8.0	19.0		
142	10.0	21.0		
143	12.0	23.0		
144	14.0	25.0		
145	16.0	27.0		

MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

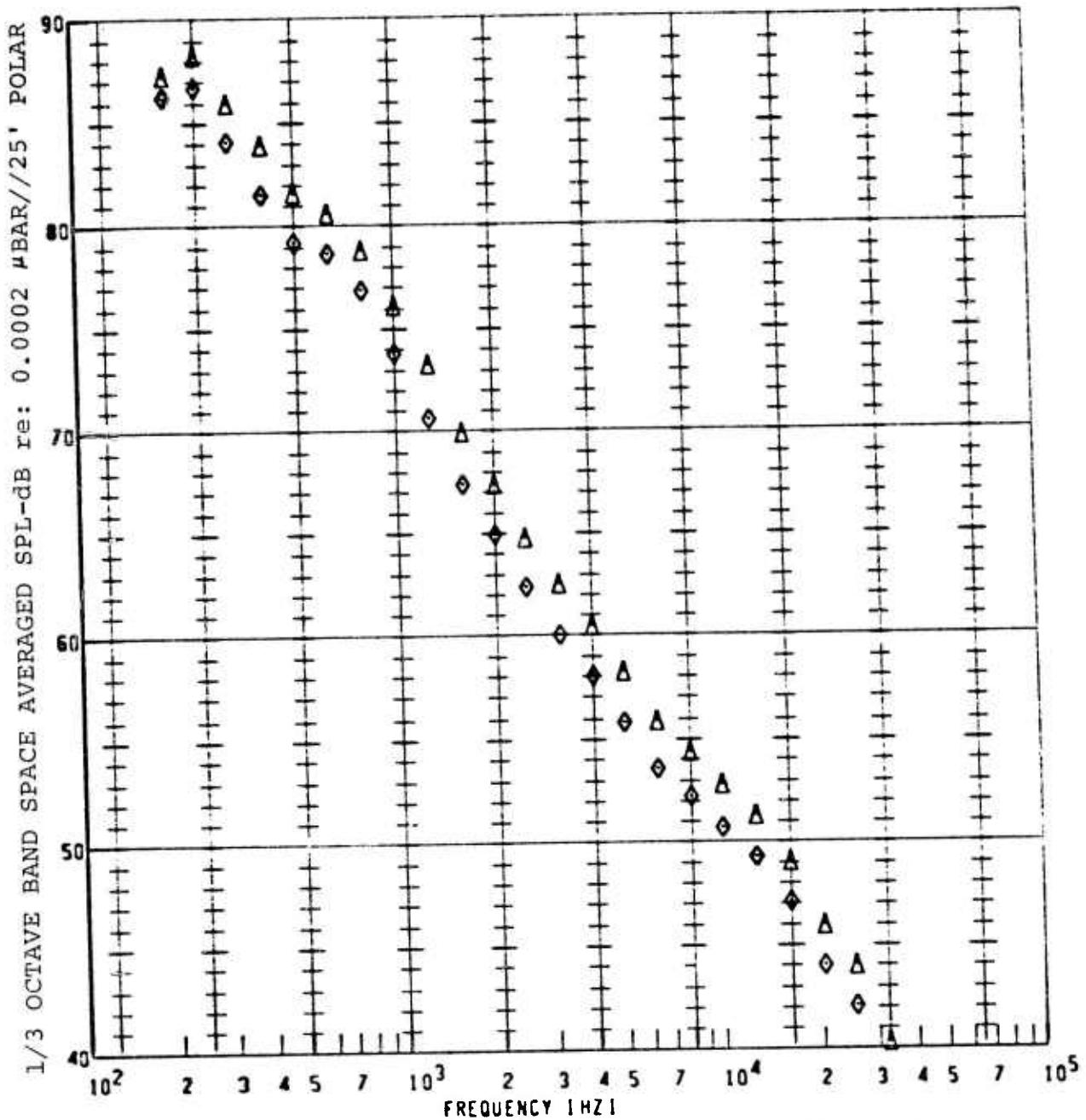


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
Δ	124	1150°F	3.000	0.0
◊	125	1150		0.25
○	126	1150		0.5
▽	127	1150		0.75
□	128	1150		1.0
○	129	1150		1.25
□	130	1150		1.50
○	131	1150		1.75
□	132	1150		2.00
○	133	1150		2.25

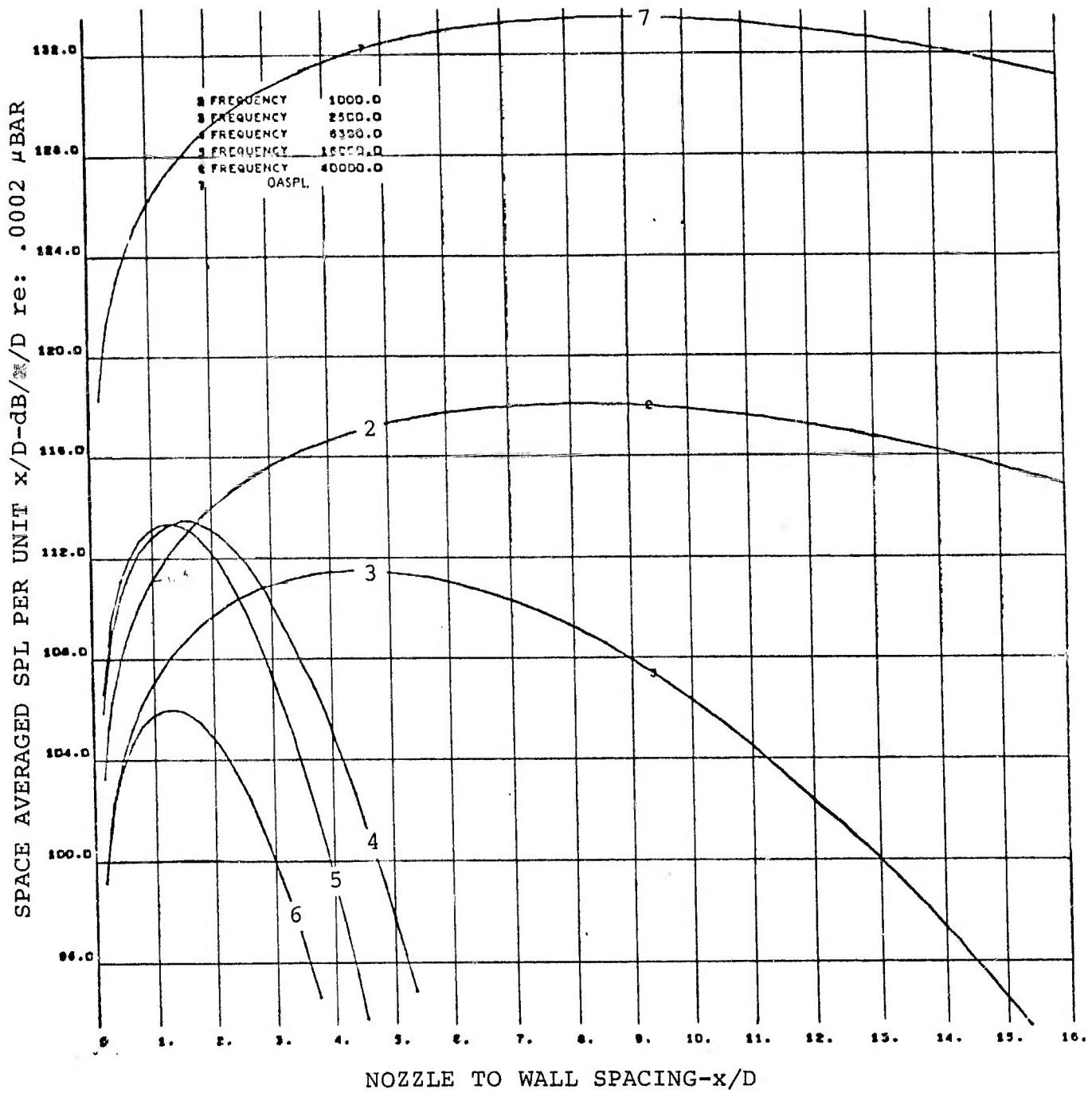


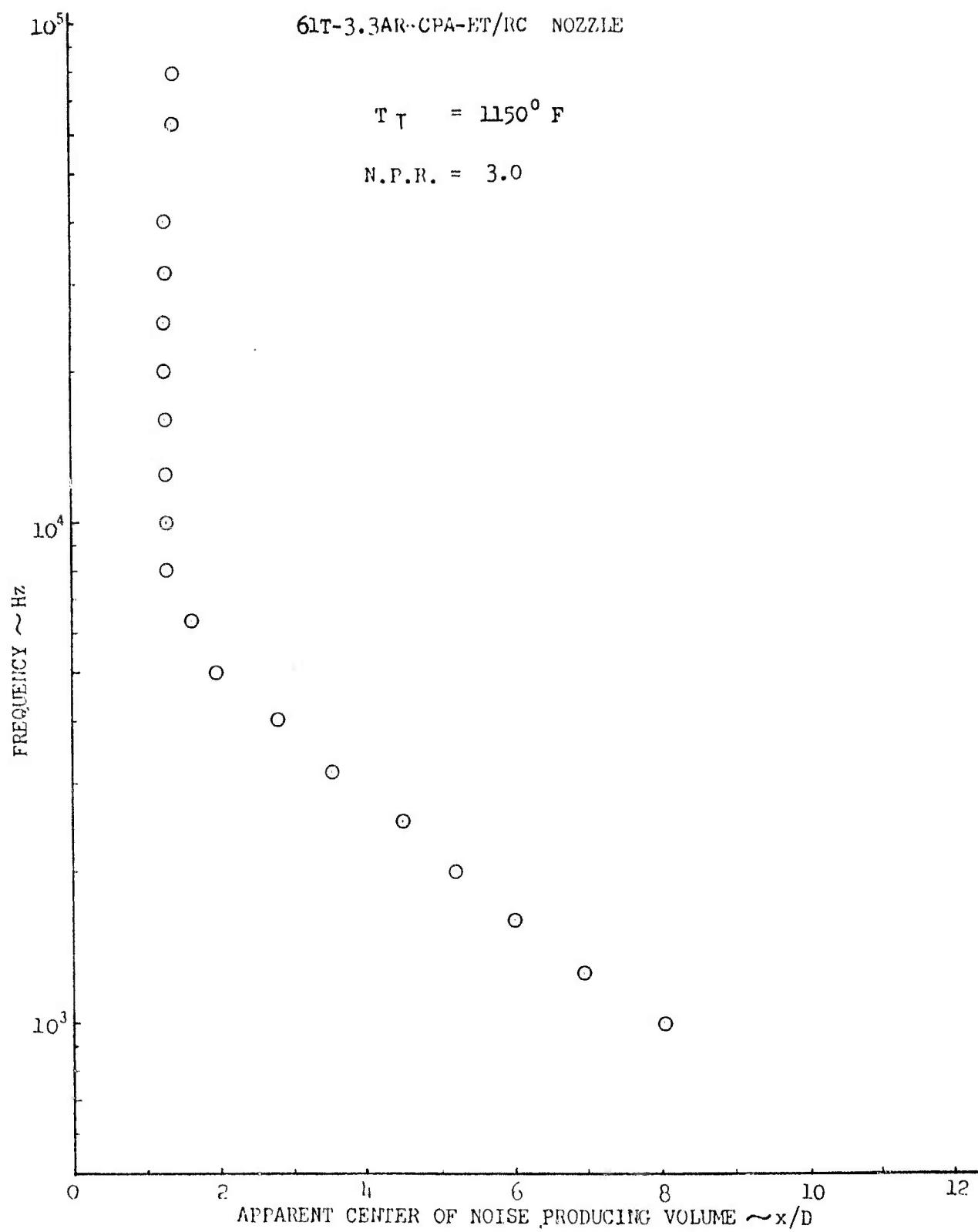
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
▲	134	1150 °F	3.000	2.50
◆	135	1150		2.75
○	136	1150		3.00
▼	137	1150		3.50
■	138	1150		4.00
□	139	1150		5.00
◇	140	1150		6.00
◆	141	1150		8.00
○	142	1150		10.00
▲	143	1150		12.00

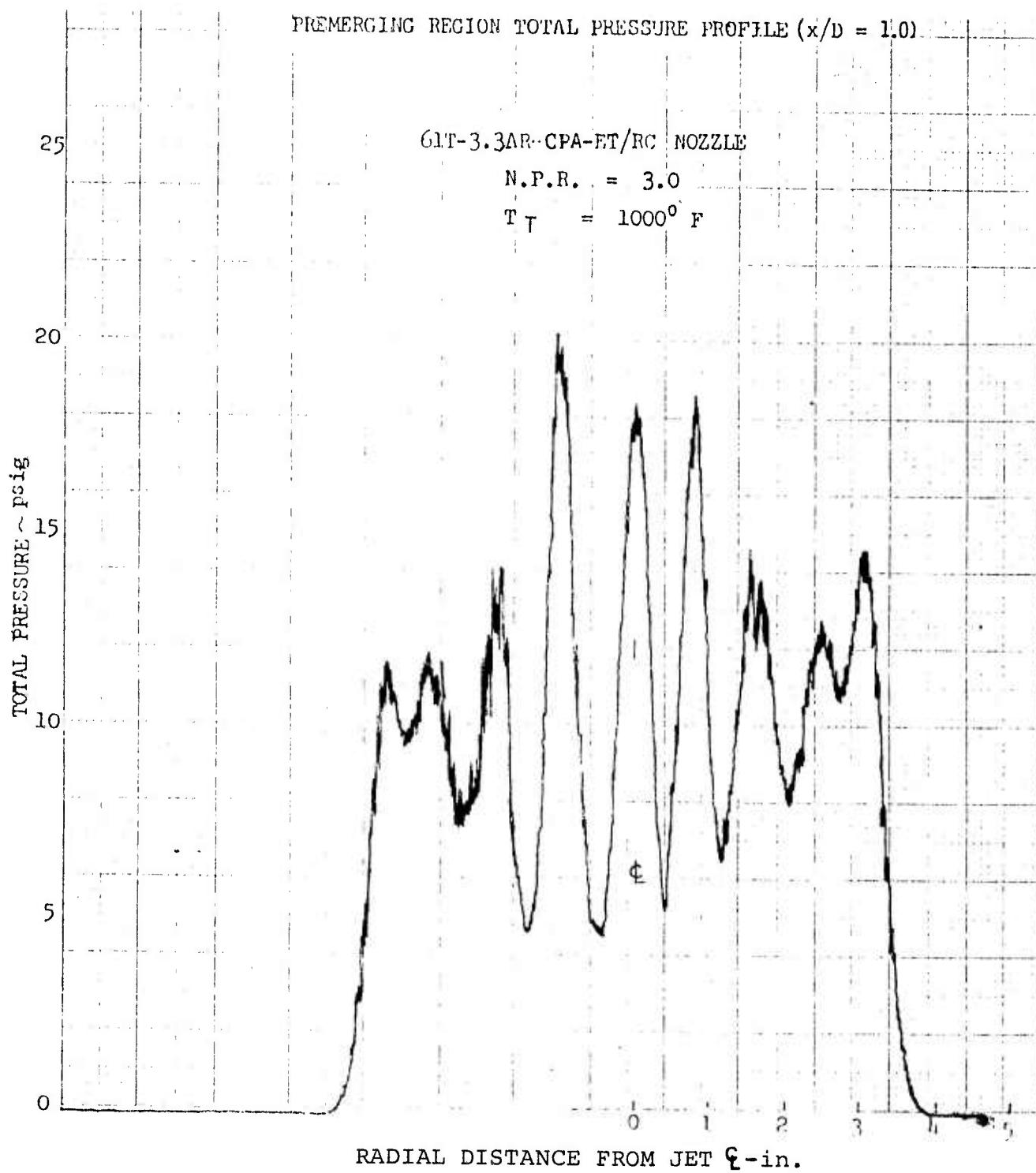
FREE FIELD VALUES

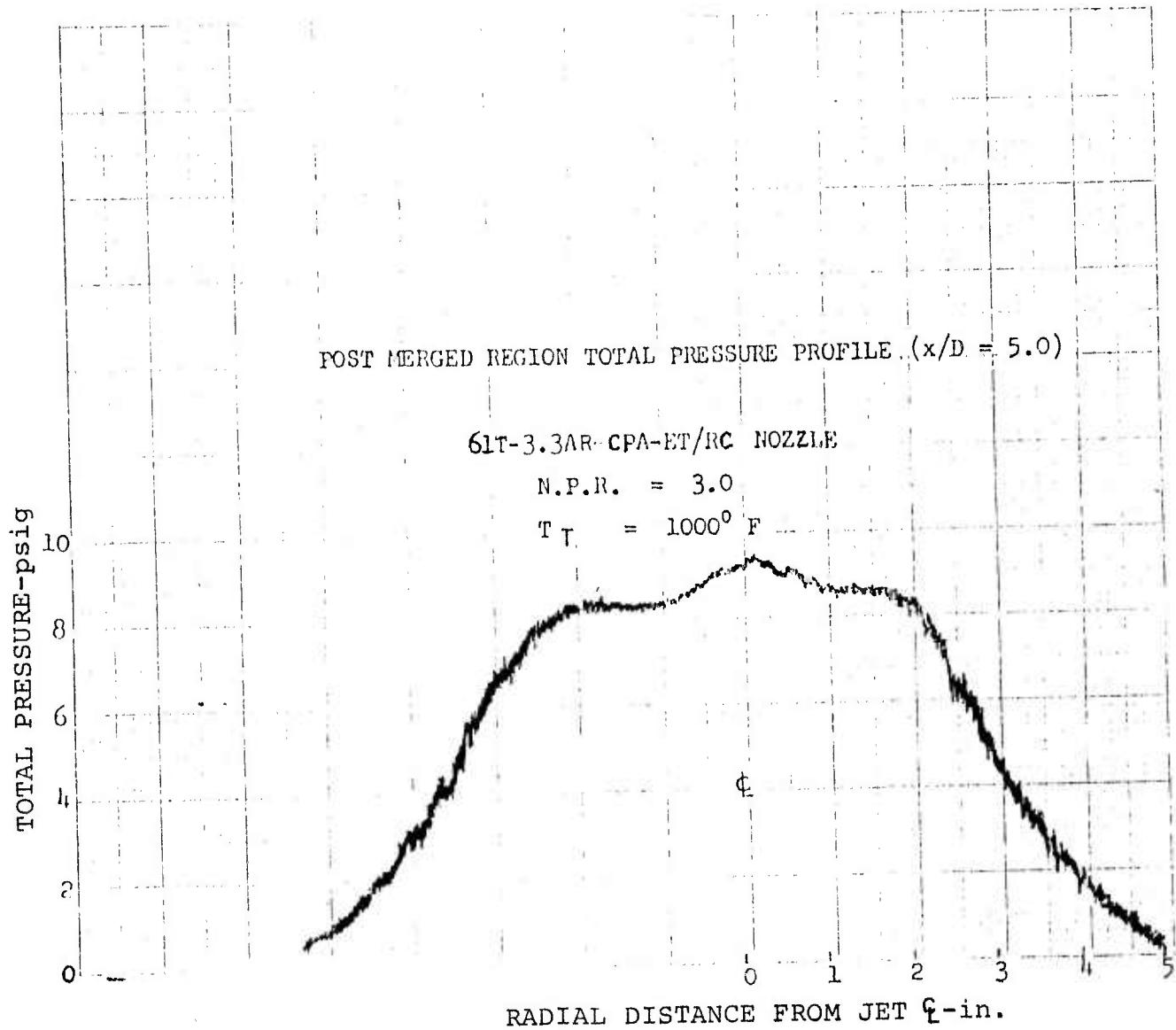


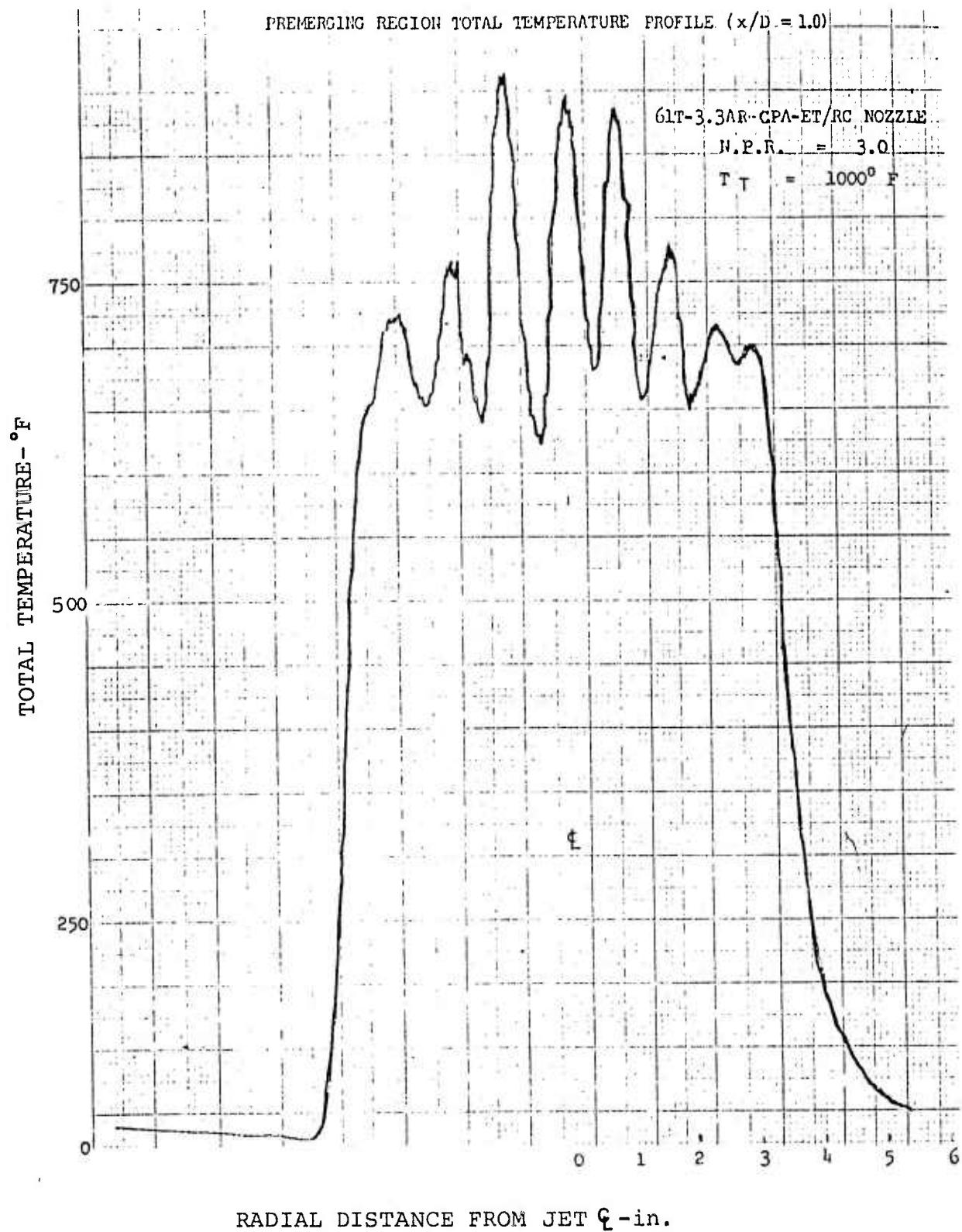
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	144	1150°F	3.0	14.00
◊	145	1150	3.0	16.00

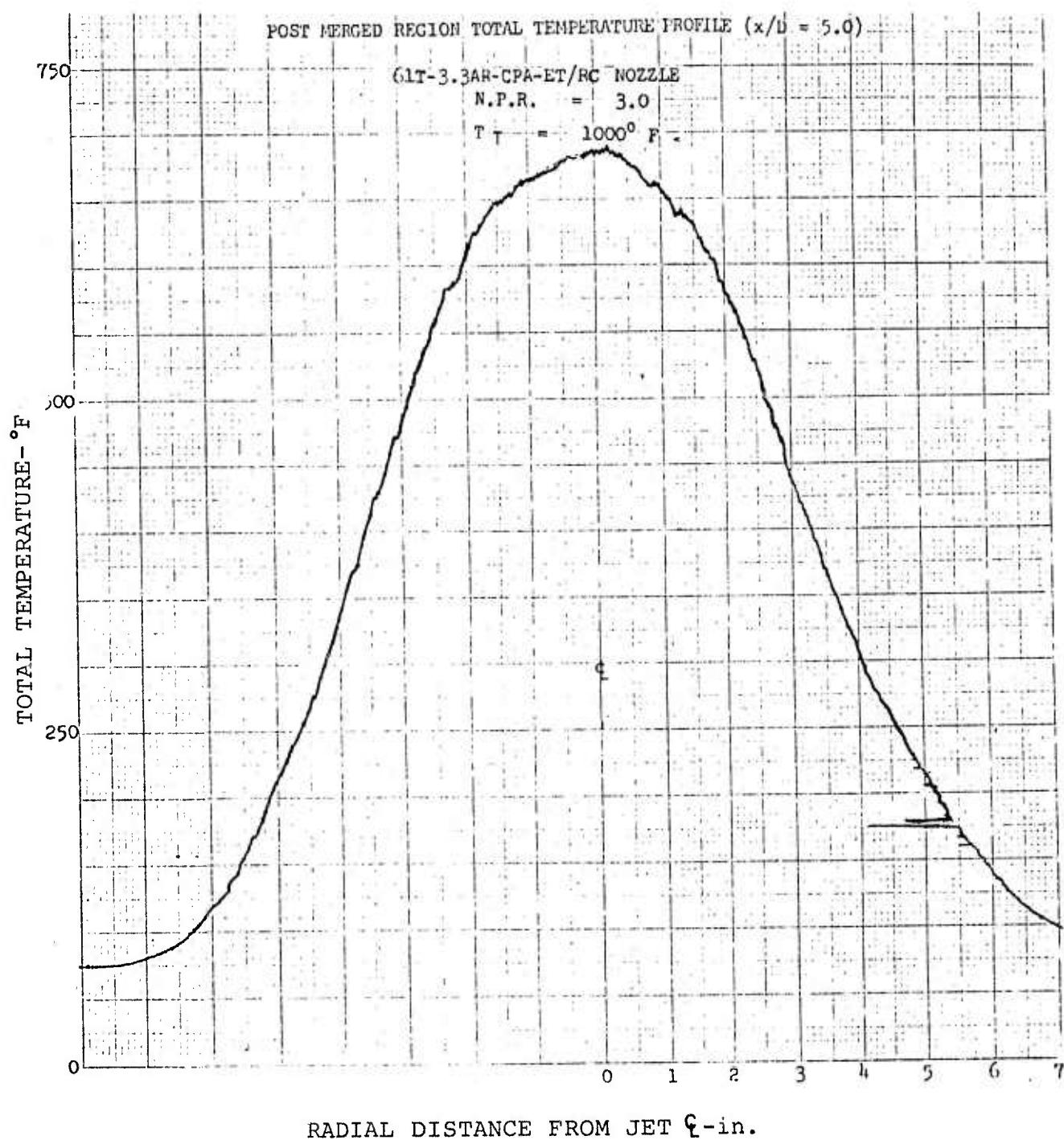


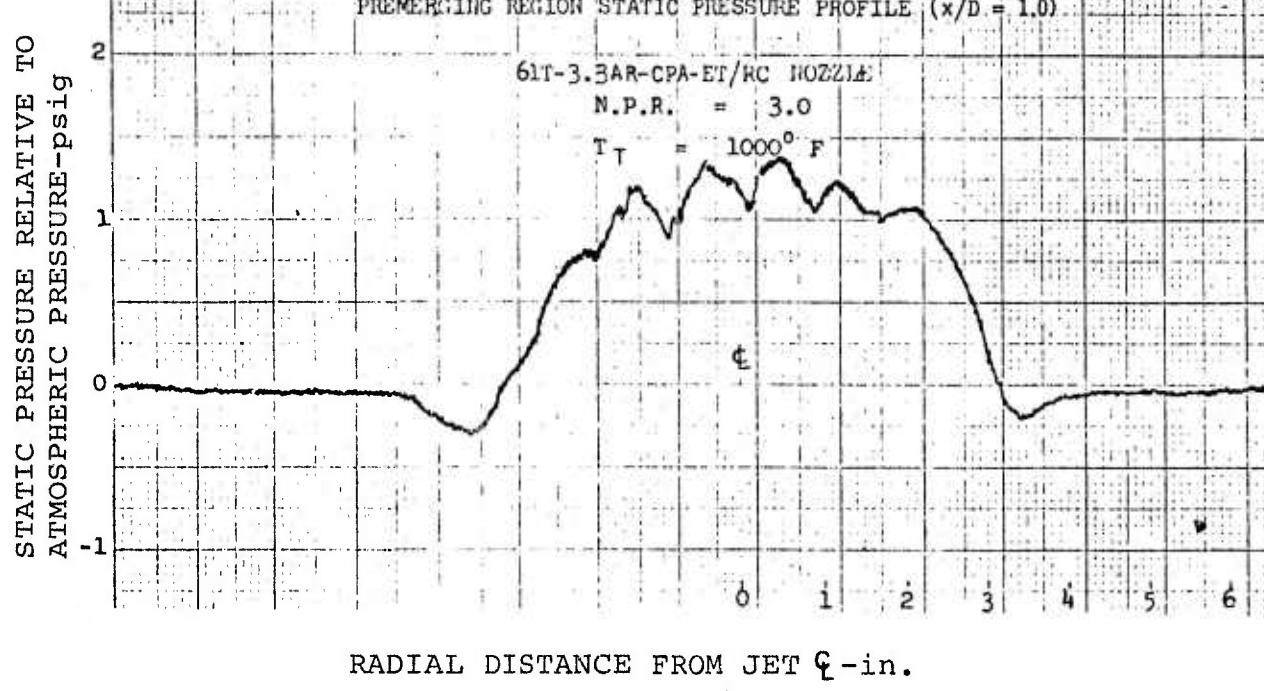




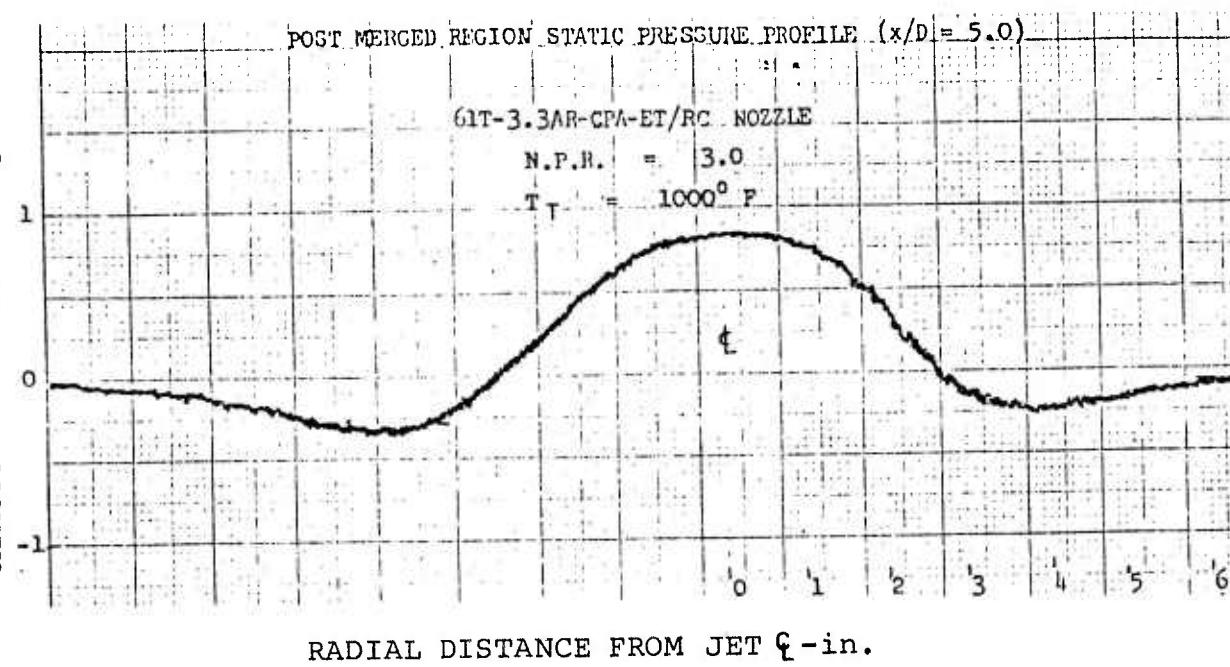


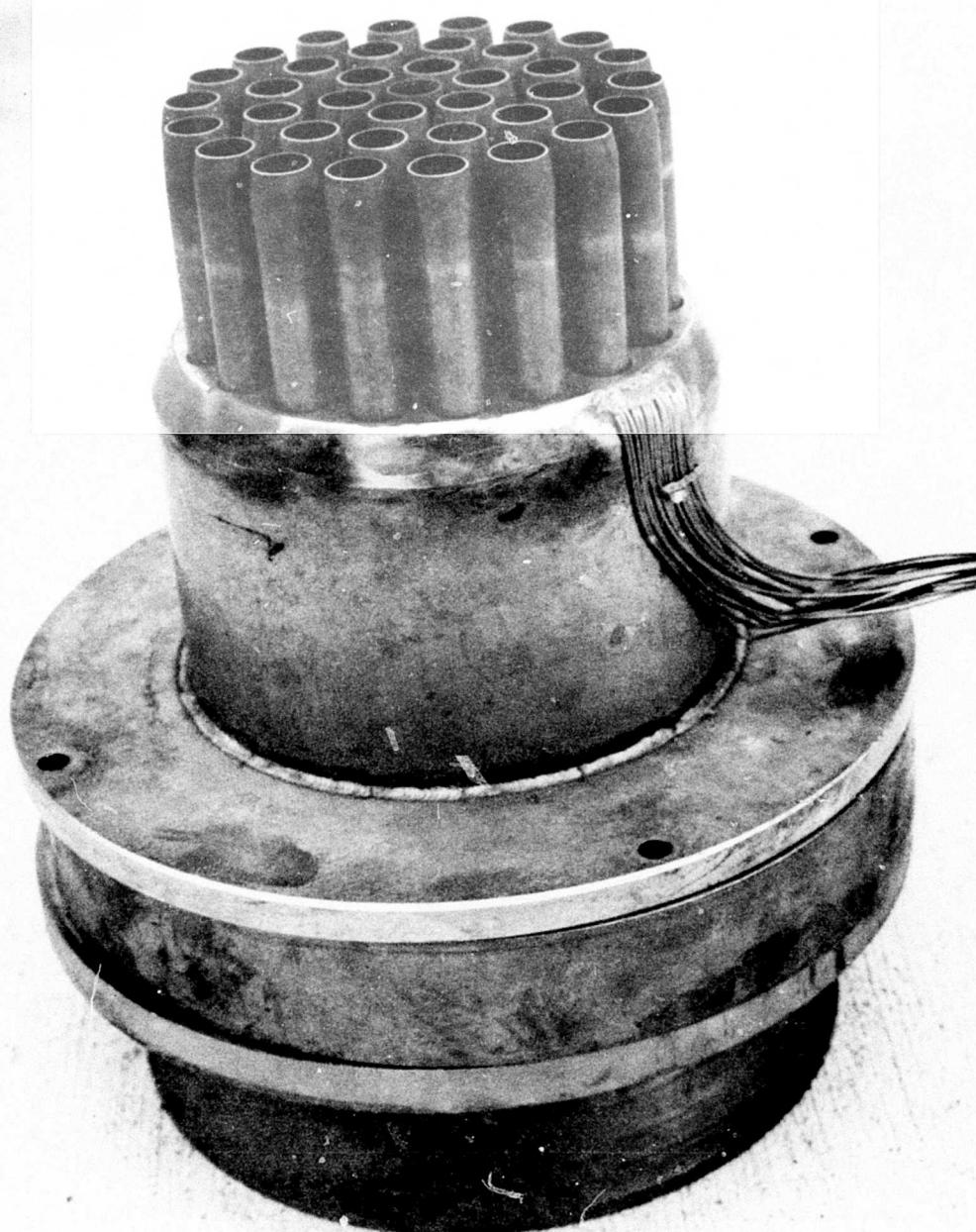




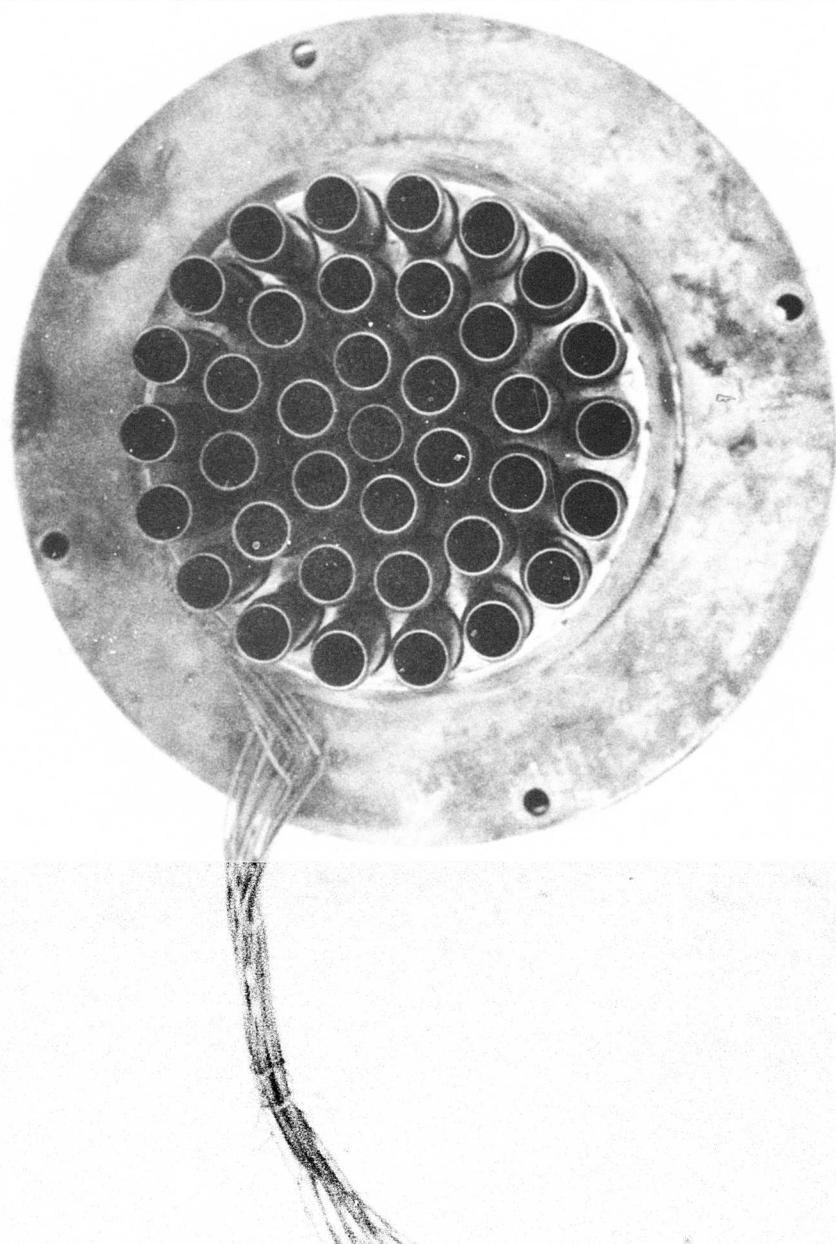


STATIC PRESSURE RELATIVE TO
ATMOSPHERIC PRESSURE - psig

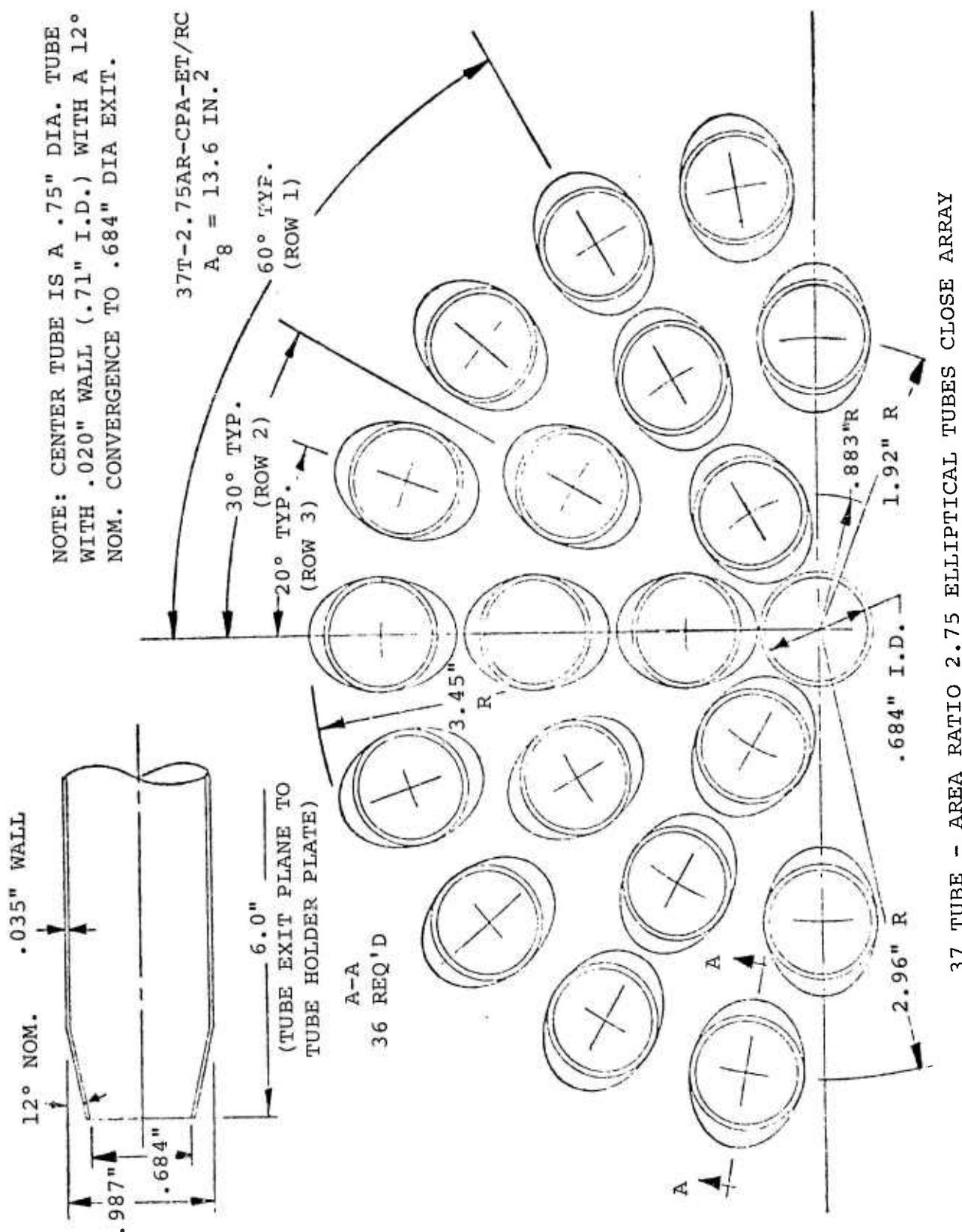




37T-2 .75AR-CPA-ET/RC NOZZLE



37T-2.75AR-CPA-ET/RC NOZZLE



TEST CONDITIONS

NOZZLE: 37T-2.75AR-CPA-ET/RC

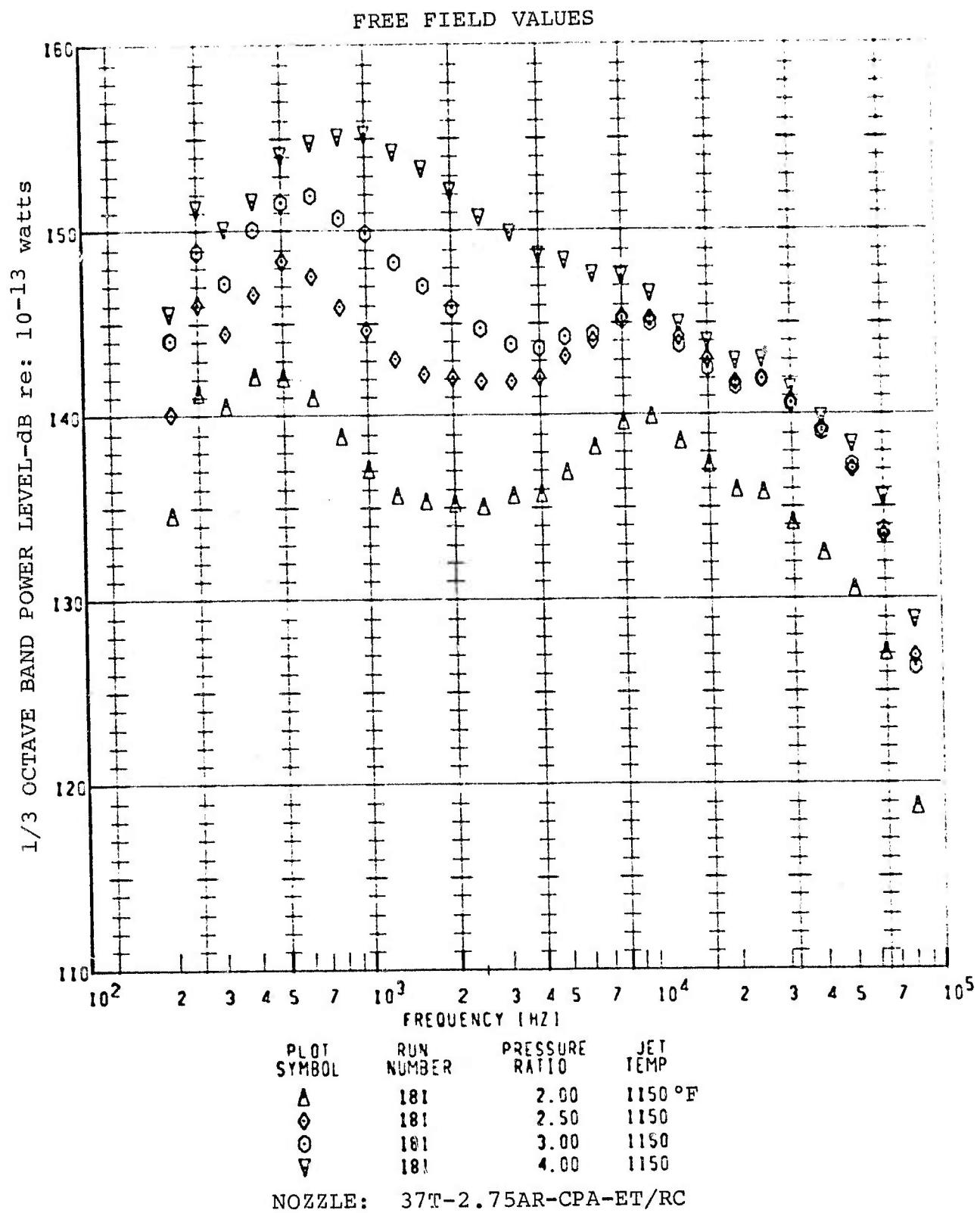
FACILITY: HNTF

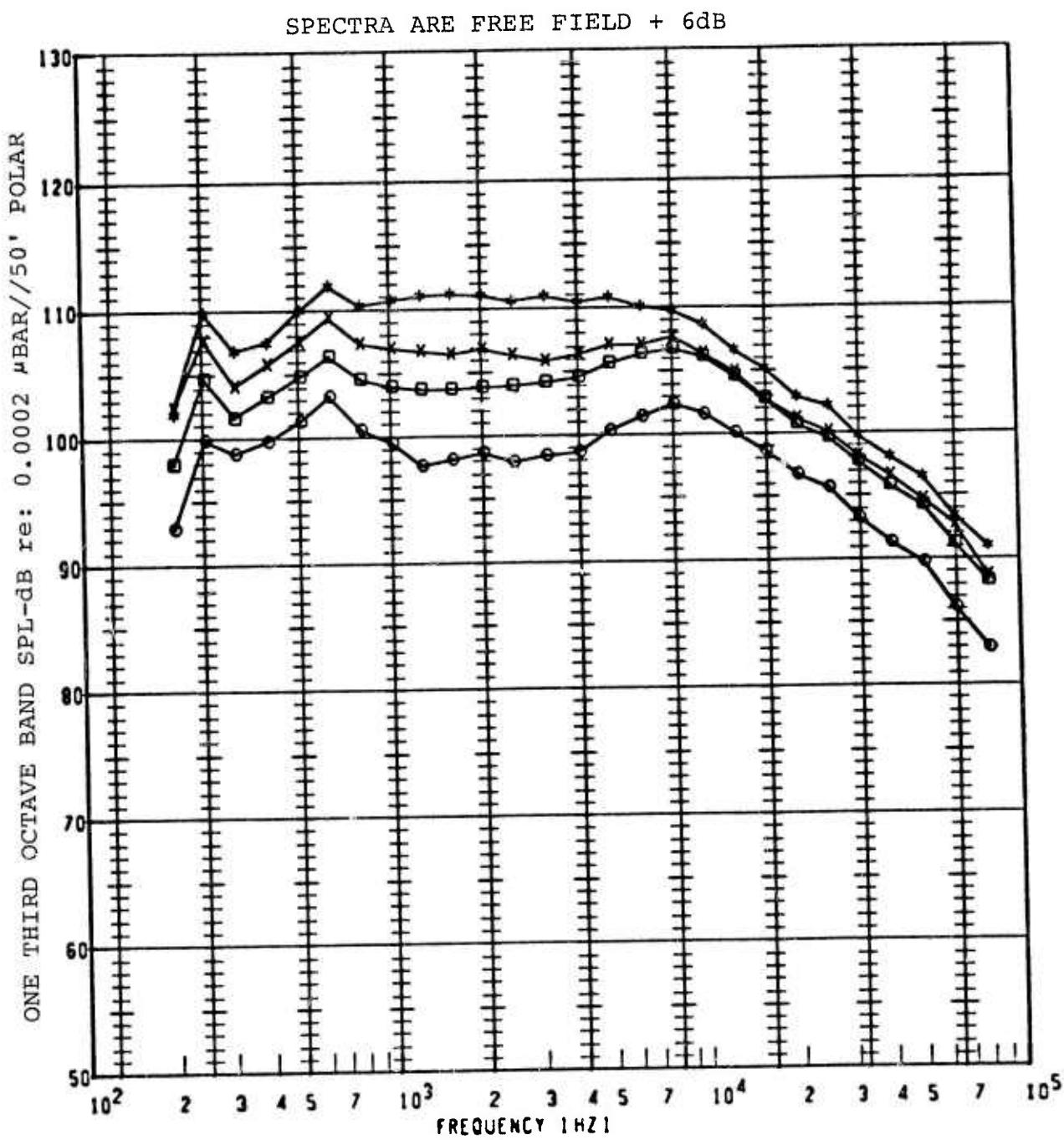
DATE: 1-10-73 **T_{AMB}** = 42 °F **R.H.** = 72%

SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
181	2.0	1150 °F	1875 fps	3" tube lengths	
"	2.5	"	2126		
"	3.0	"	2303		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



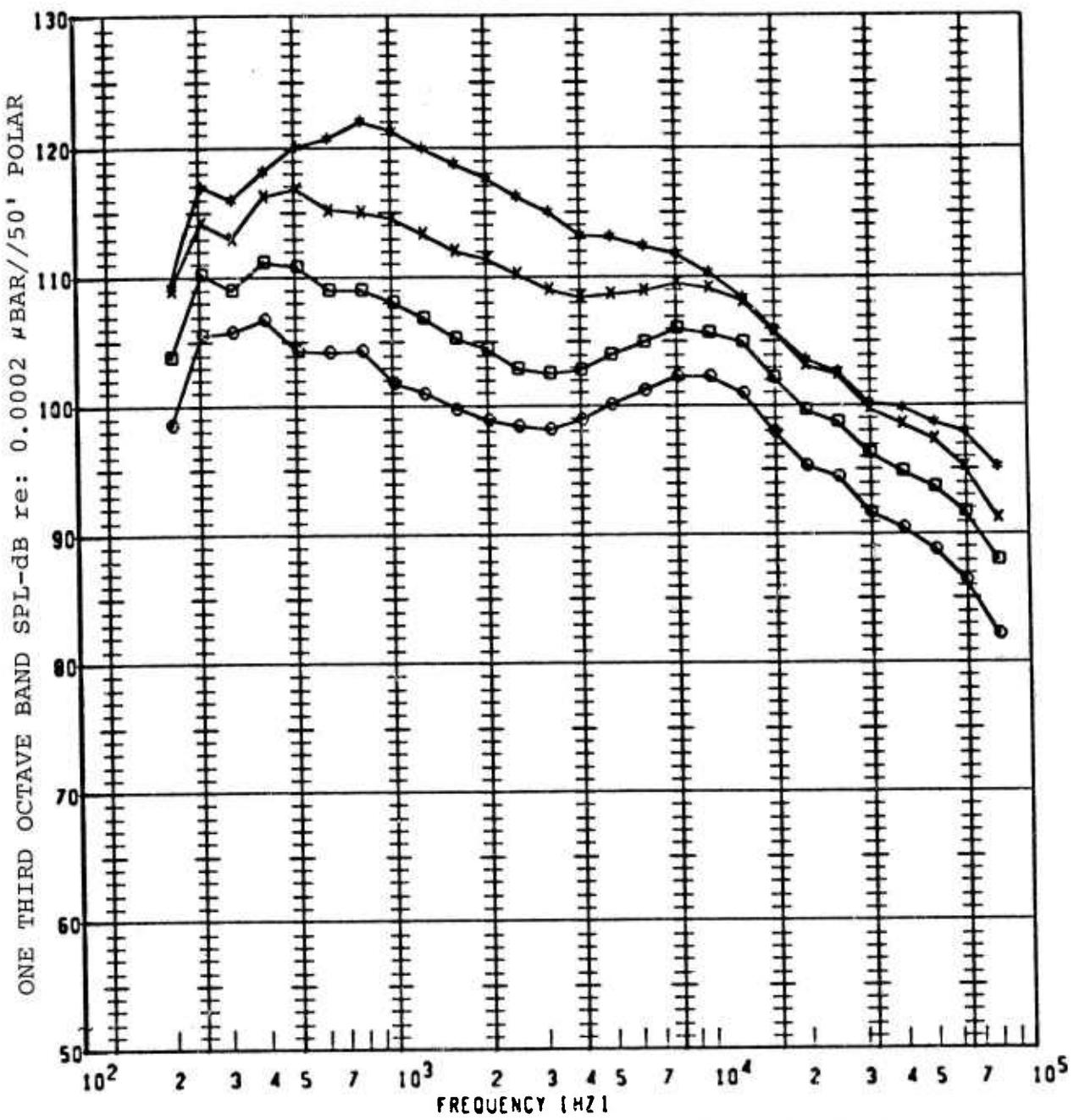


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL (dB)
○	181G	1150° F	2.000	110°	SOFP	113.2
□	181G	1150	2.500		SOFP	117.8
×	181G	1150	3.000		SOFP	119.8
*	181G	1150	4.000	↓	SOFP	122.9

NOZZLE: 37T-2.75AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

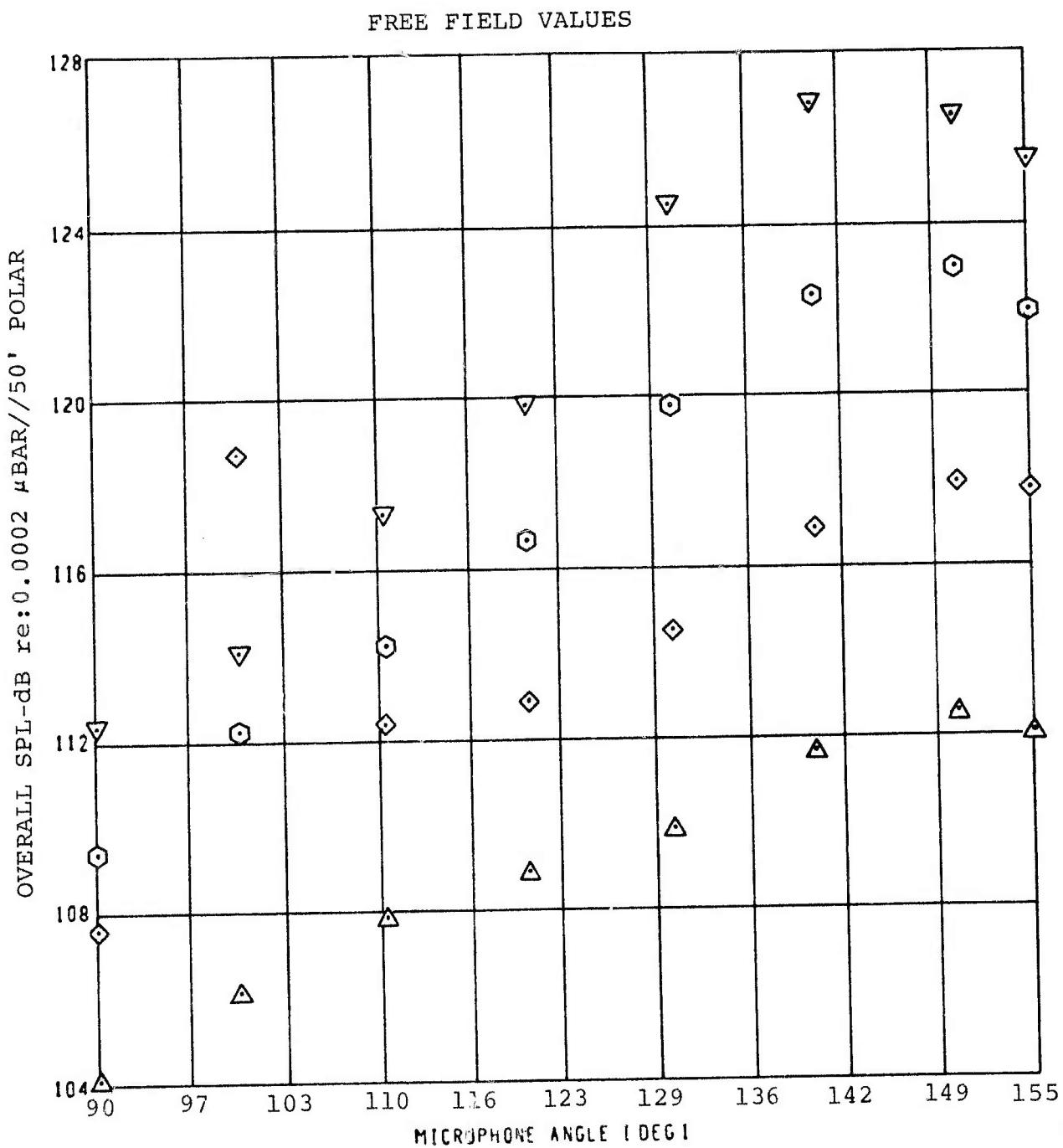
SPECTRA ARE FREE FIELD + 6dB



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL 1081
○	181G	1150°F	2.000	130°	SOFP	115.6
□	181G	1150	2.500		SOFP	120.2
×	181G	1150	3.000		SOFP	125.6
*	181G	1150	4.000		SOFP	130.4

NOZZLE: 37T-2.75AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	181	2.00	1150°F
◊	181	2.50	1150
○	181	3.00	1150
▽	181	4.00	1150

NOZZLE: 37T-2.75AR-CPA-ET/RC

OASPL BEAM PATTERNS

SAE RC NOZZLE
 $A_g = 12.6 \text{ FT}^2$

AVERAGE RC NOZZLE

37T-2-75AR-CPA-ET/RC
1000' ALTITUDE
20° ENGINE ATTITUDE
4 ENGINES
FAR 36 STD DAY (77° F, 70% RH)
3 PNdB ABOVE FREE FIELD
SCALE FACTOR: 8
FULL SCALE: $A_g = 6.05 \text{ FT}^2$

145

140

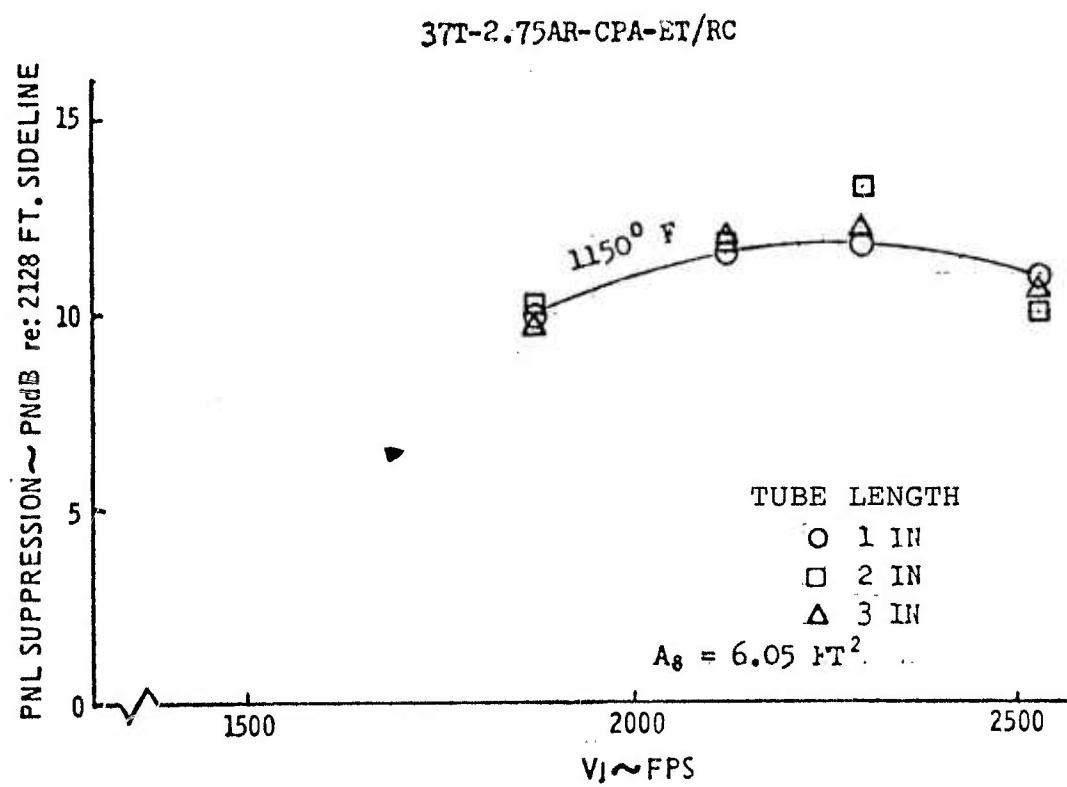
135

130

125

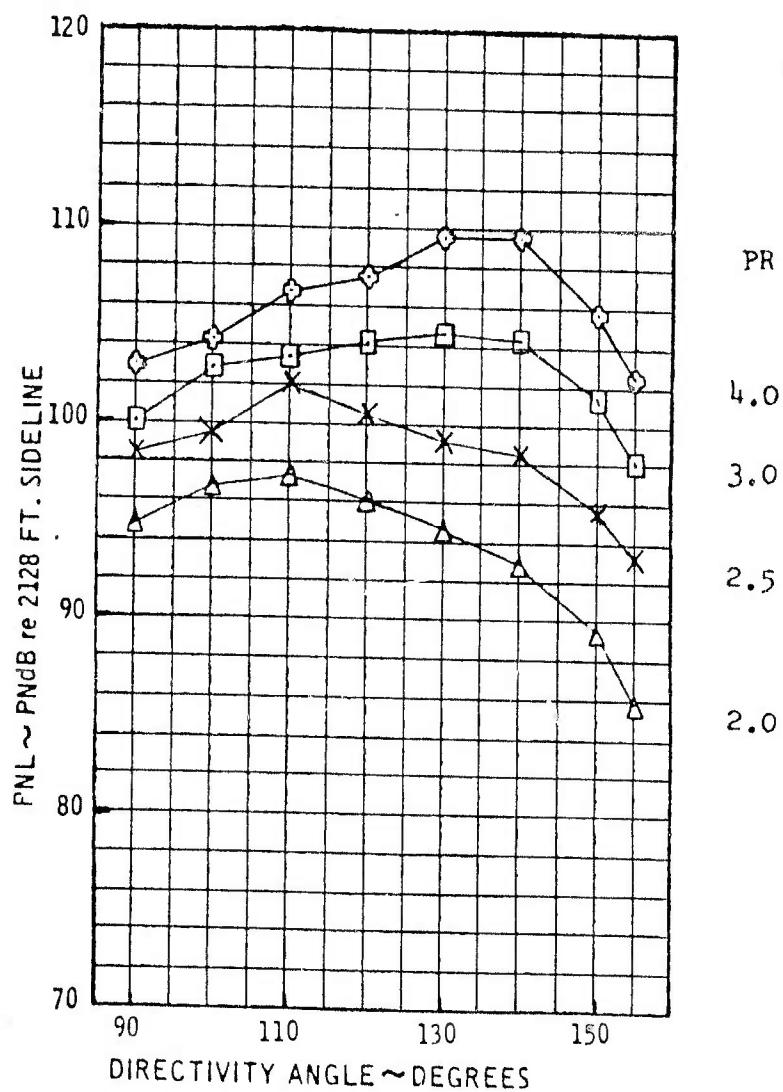
120

PNL_{MAX} - $10 \log_{10} A_g^2 / PNdB$ re: 2128 FT. SIDELINE



PEAK PNL SUPPRESSION VALUES

NOZZLE: 37T-2.75AR-CPA-ET/RC

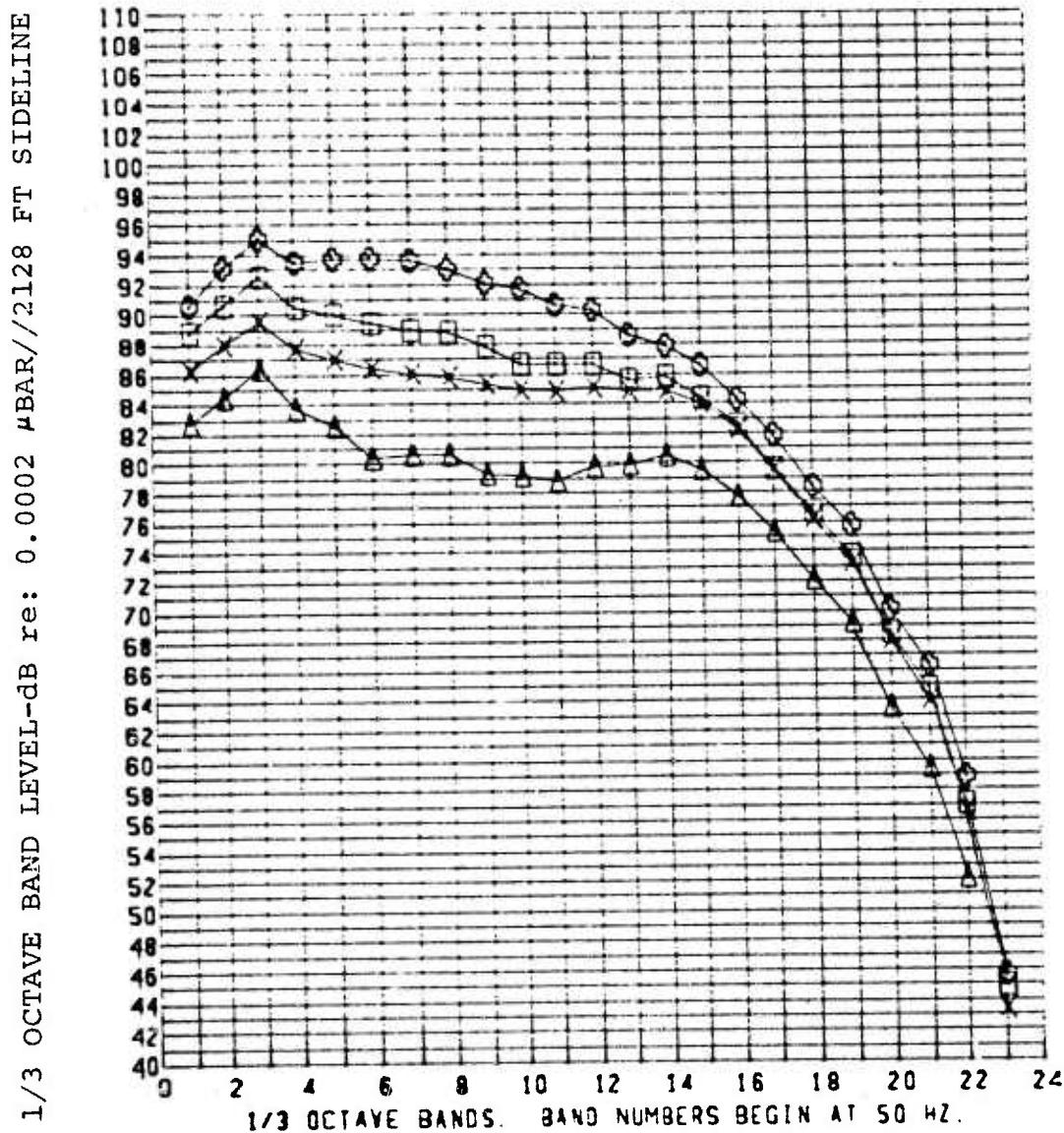


RUN 181
 $T_T = 1150^{\circ} F$ $A_s = 6.05 \text{ FT}^2$

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT

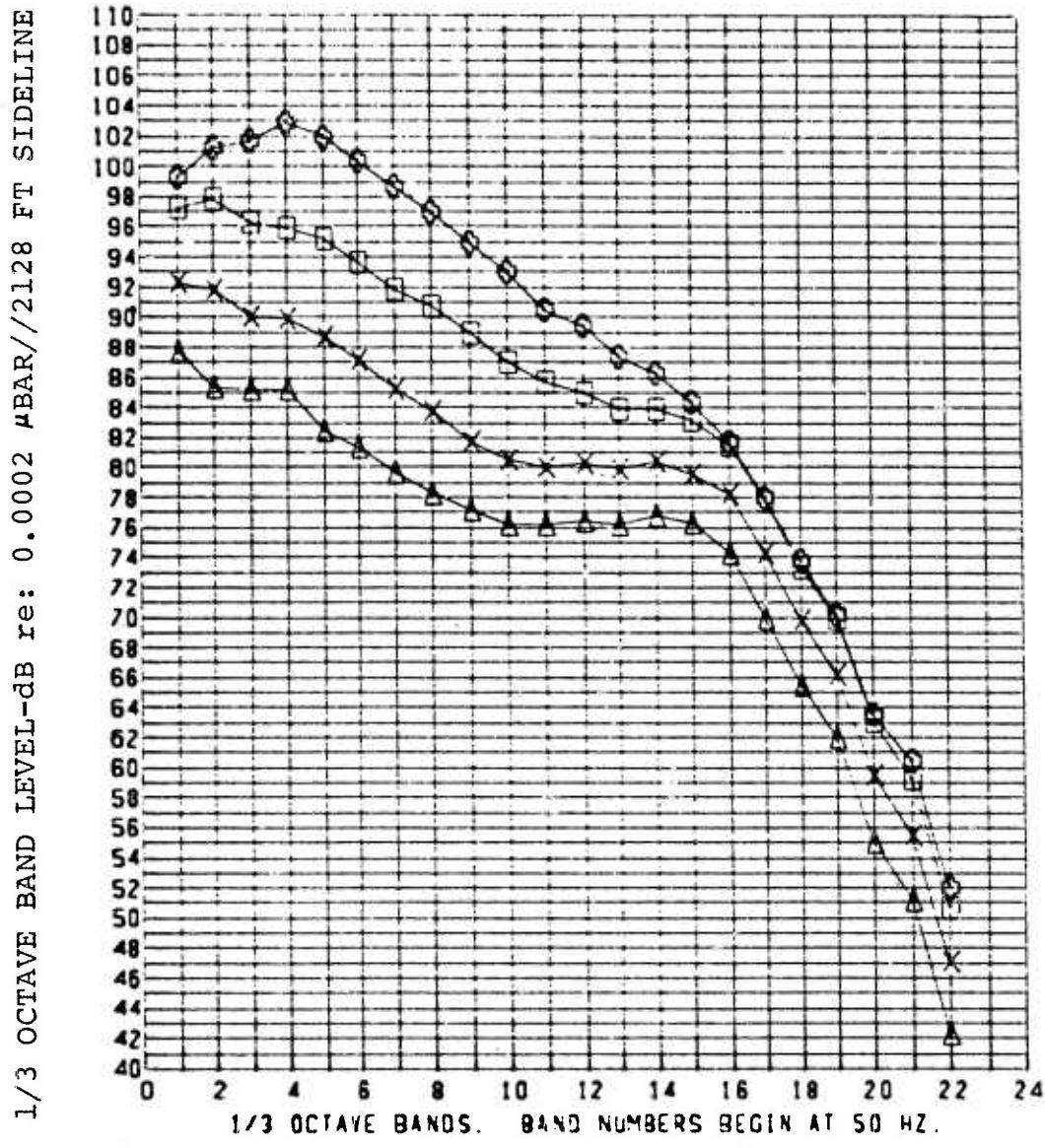


NOZZLE: 37T-2.75AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°

re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 37T-2.75AR-CPA-ET/RC

FACILITY: WALL ISOLATION FACILITY

DATE: January 17, 1973

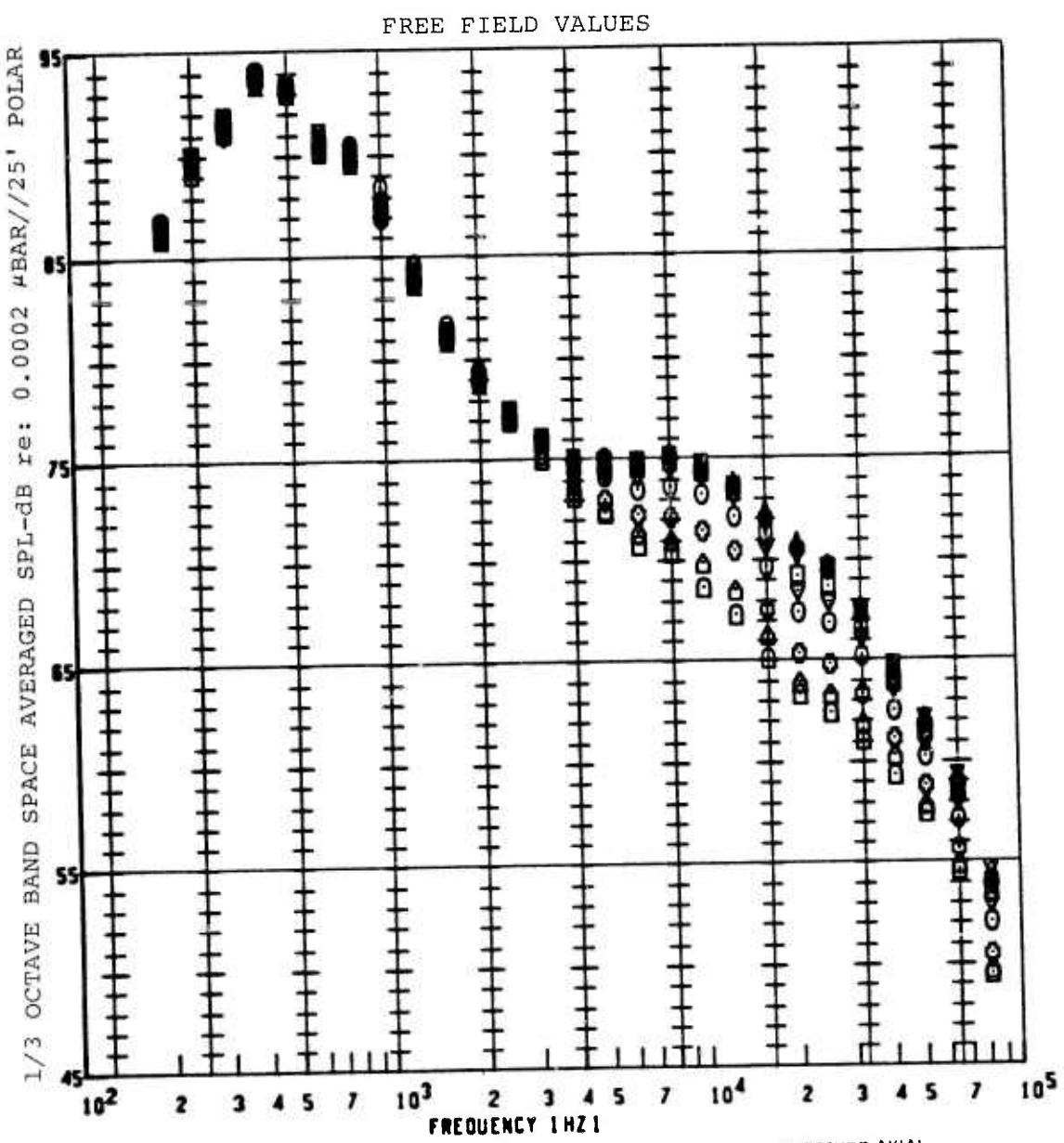
P_{AMB} = 29.73 in Hg **T_{AMB}** = 44°F **R.H.** = 88%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

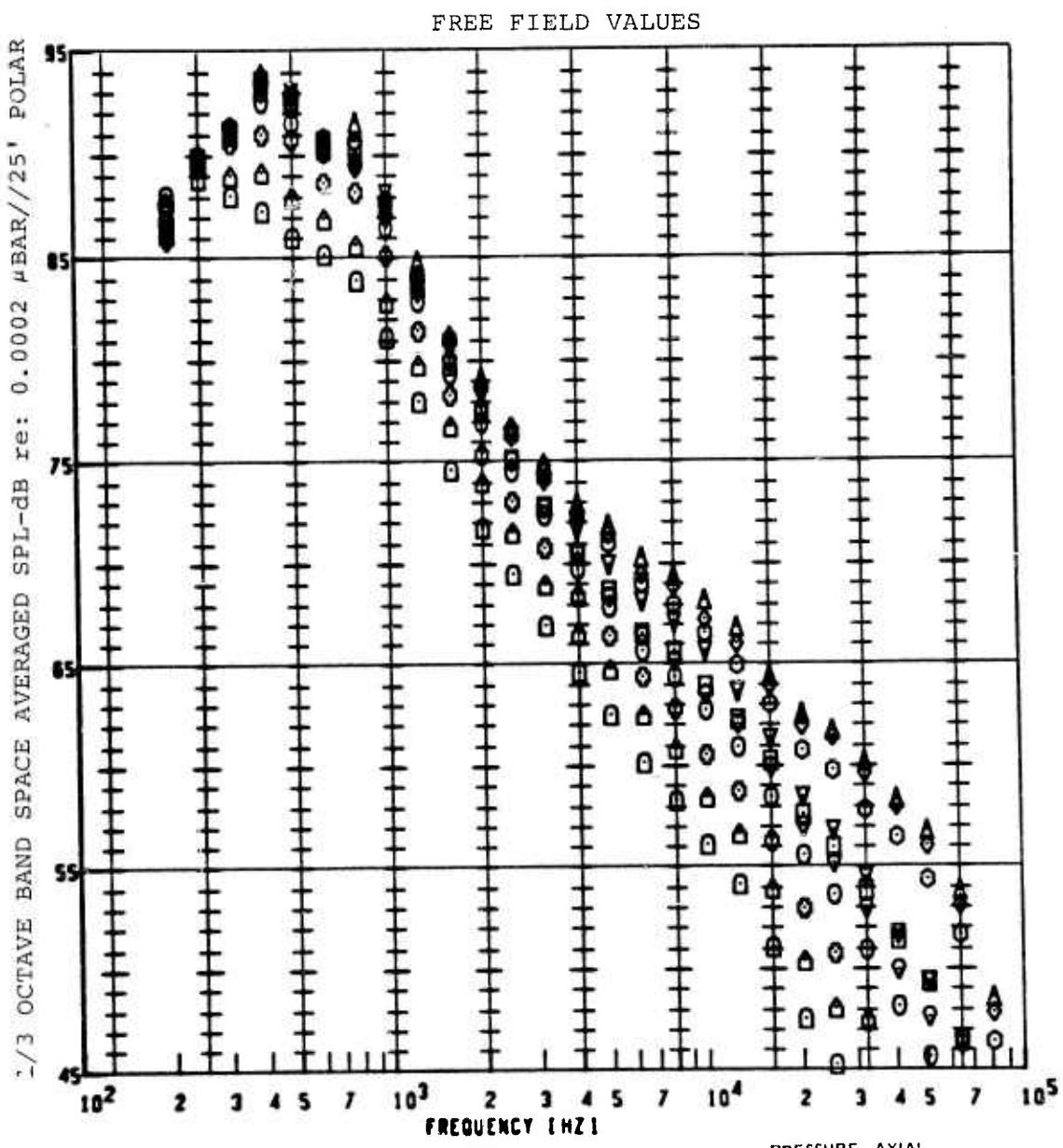
SCALE MODEL A₈ = 13.6 in.²

RUN NO.	AXIAL LOCATION	IRIS DIA.	REMARKS	REF.
50	0.0 x/D	9.0 in.		
51	0.25	9.0		
52	0.50	10.0		
53	0.75	9.5		
54	1.00	10.5		
55	1.25	9.5		
56	1.50	10.0		
57	1.75	10.0		
58	2.0	10.5		
59	2.25	10.5		
60	2.50	11.0		
61	2.50	11.0		
62	3.0	11.5		
63	3.5	12.0		
64	4.0	12.5		
65	5.0	13.0		
66	6.0	14.0		
67	8.0	16.0		
68	10.0	18.0		
69	12.0	20.0		
70	14.0	21.5		
71	16.0	23.5		

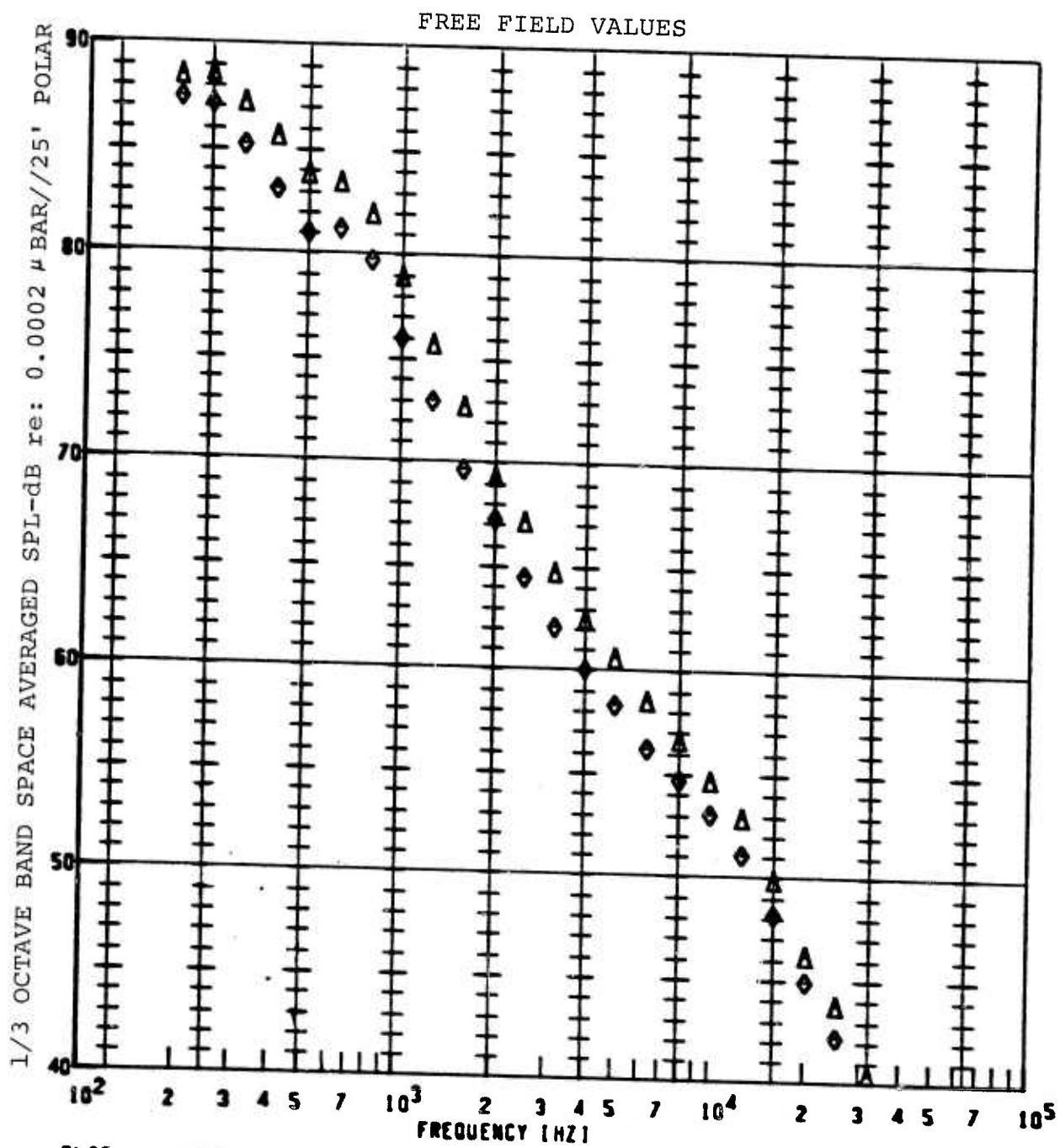
MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

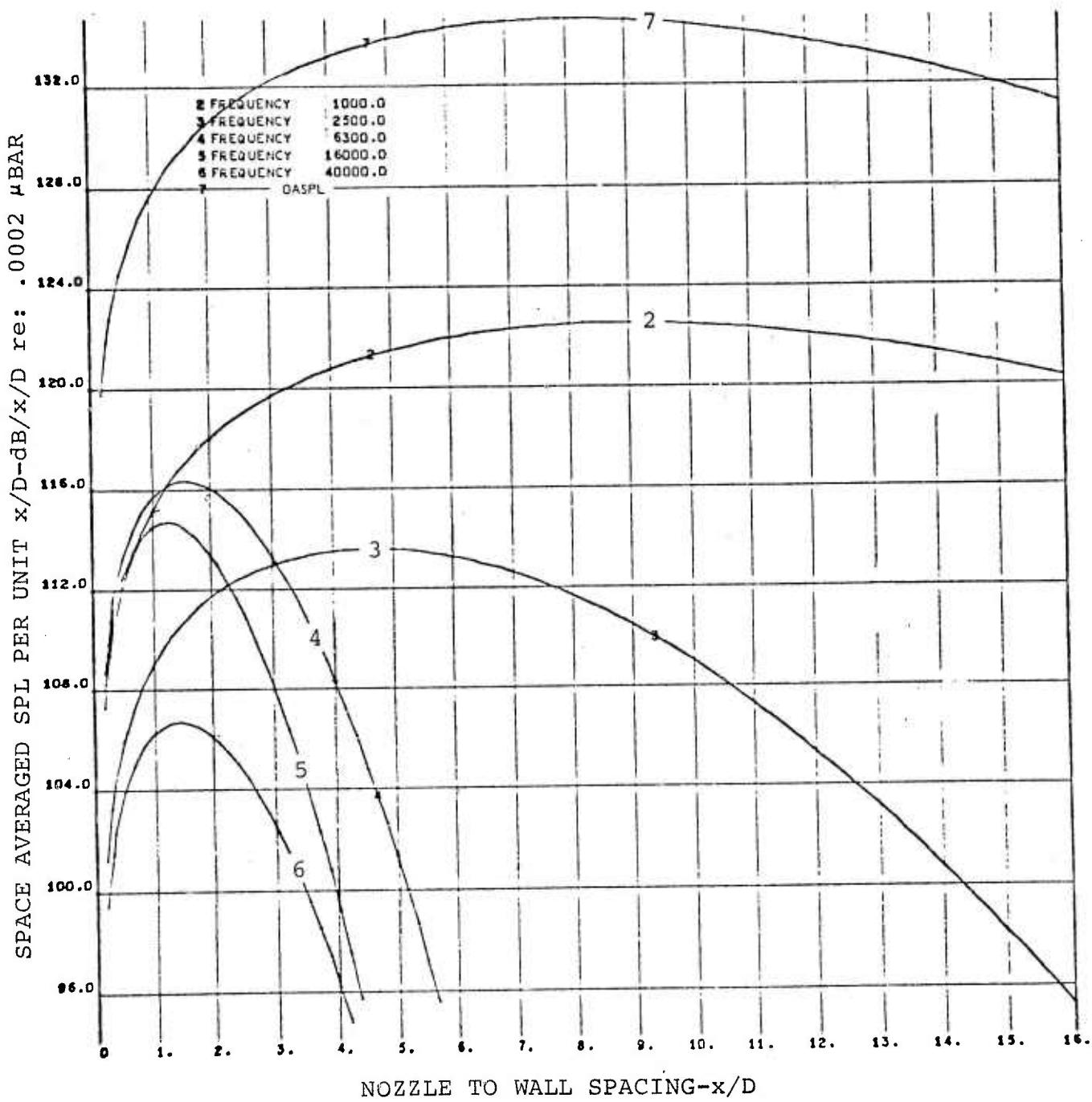


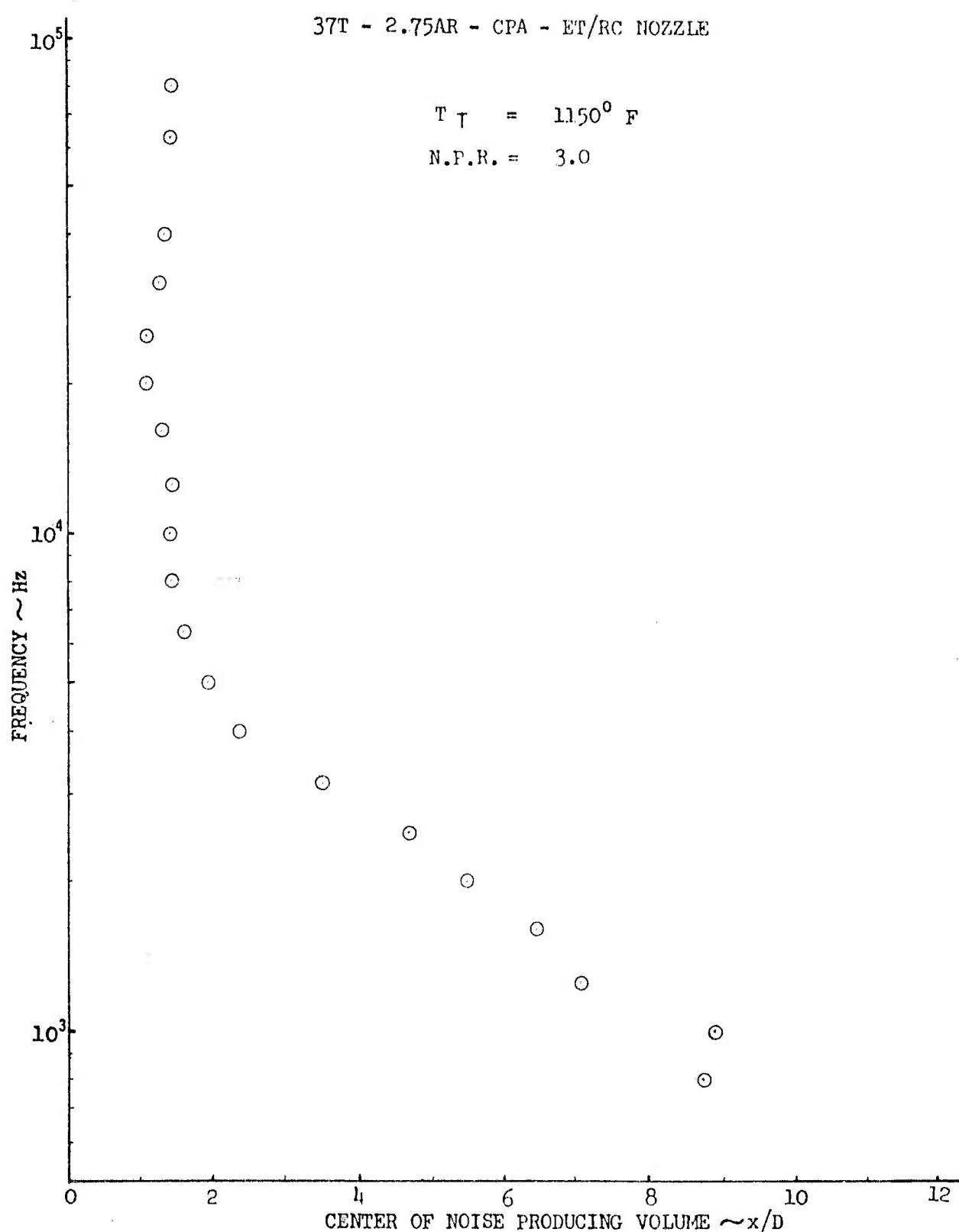
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE AXIAL RATIO LOCATION, x/D
△	50	1150°F	3.000 0.00
○	51	1150	3.000 0.25
◆	52	1150	3.000 0.50
◇	53	1150	3.000 0.75
□	54	1150	3.000 1.00
○	55	1150	3.000 1.25
◆	56	1150	3.000 1.50
◇	57	1150	3.000 1.75
□	58	1150	3.000 2.00
○	59	1150	3.000 2.25

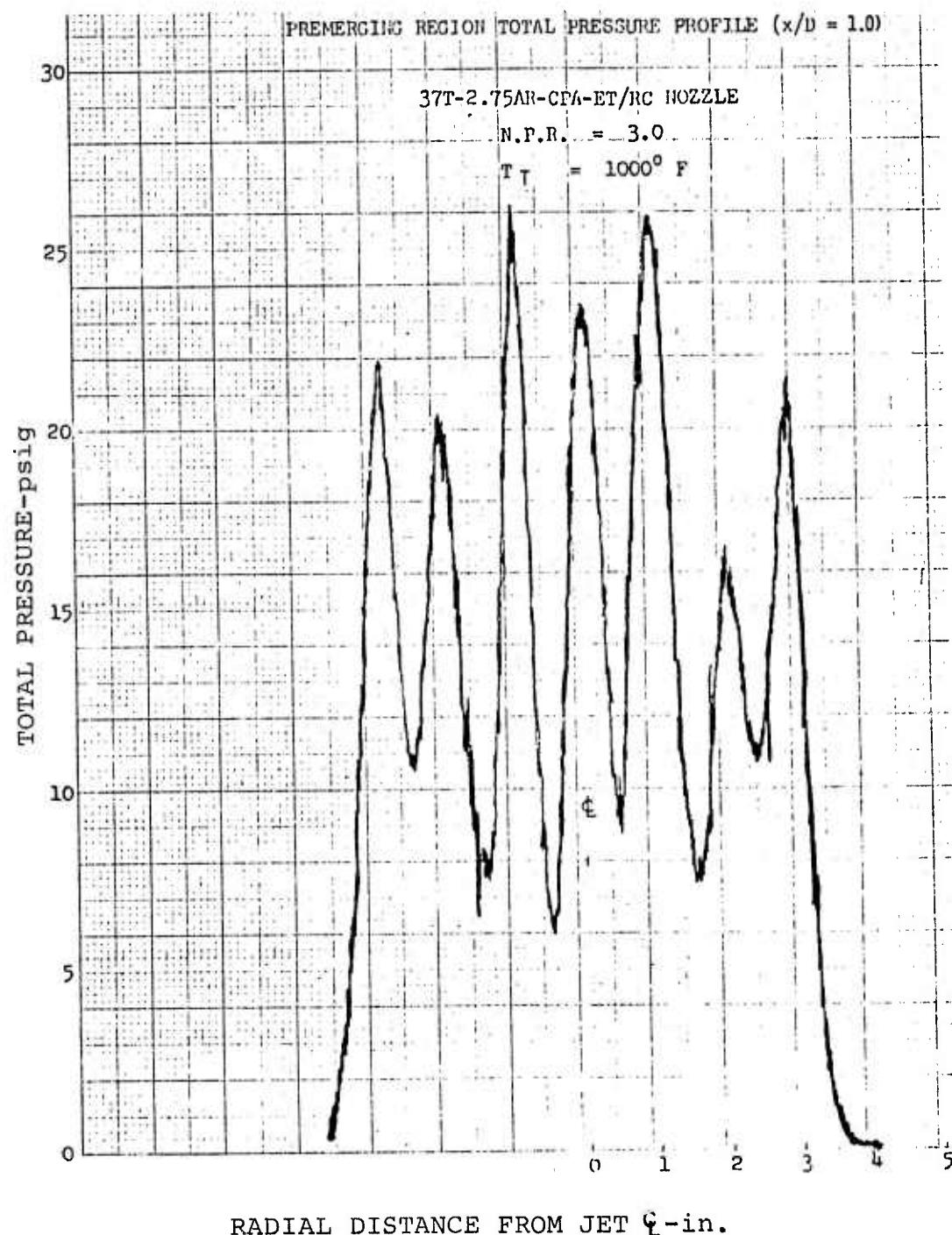


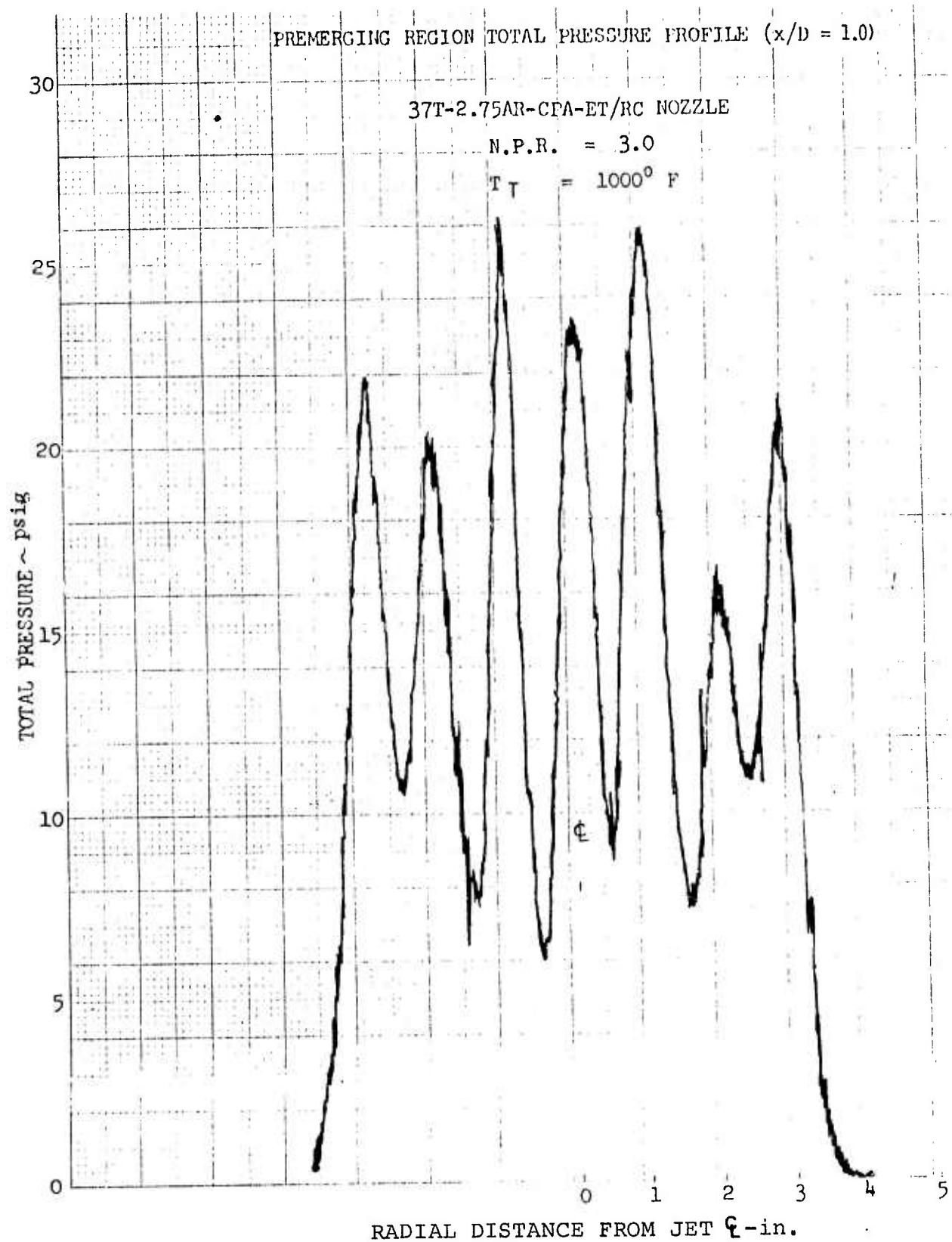
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE AXIAL RATIO LOCATION, x/D
△	60	1150°F	3.000 2.50
◆	61	1150	3.000 2.50
□	62	1150	3.000 3.00
○	63	1150	3.000 3.50
▽	64	1150	3.000 4.00
■	65	1150	3.000 5.00
○	66	1150	3.000 6.00
▽	67	1150	3.000 8.00
○	68	1150	3.000 10.00
△	69	1150	3.000 12.00

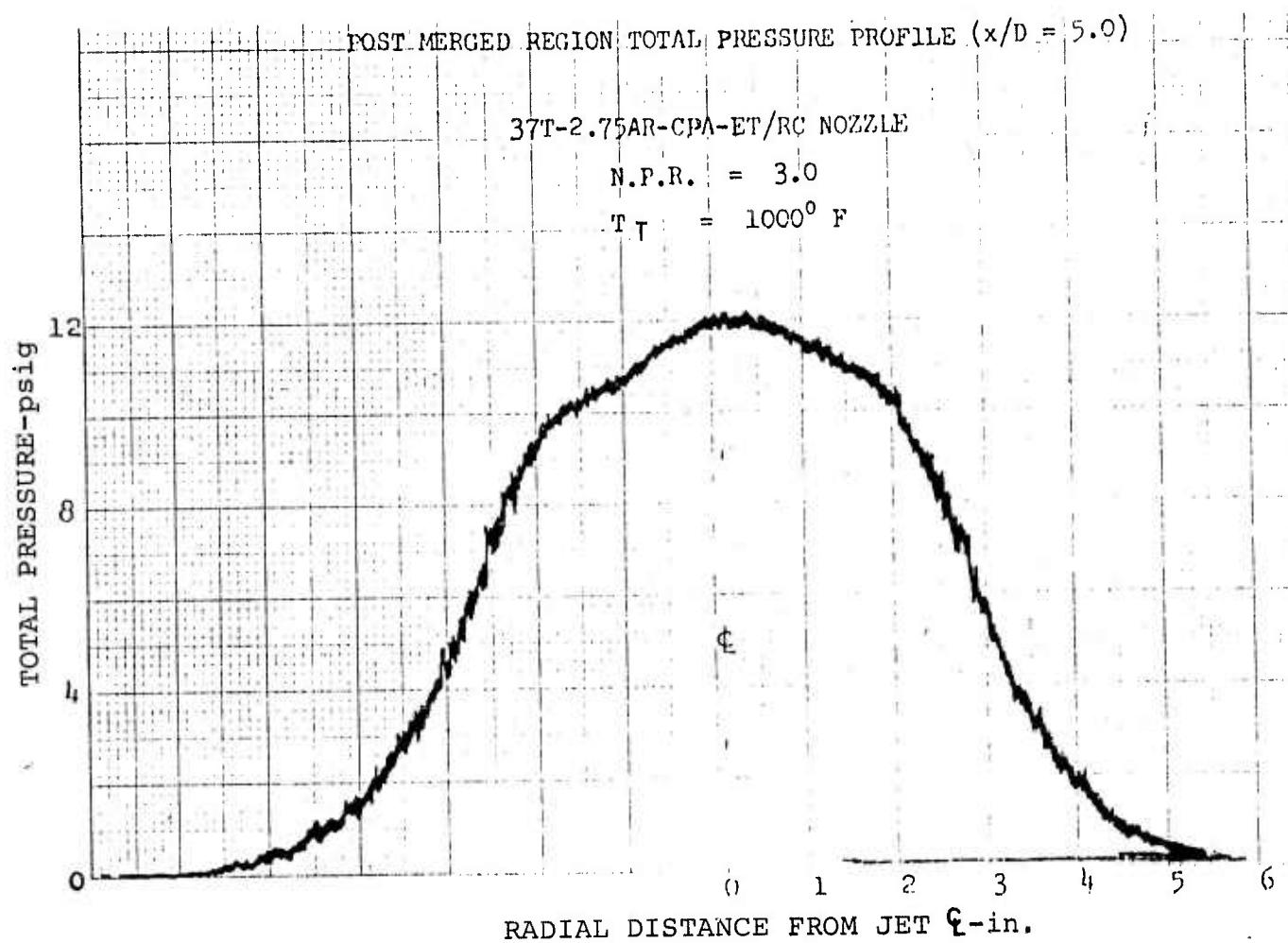


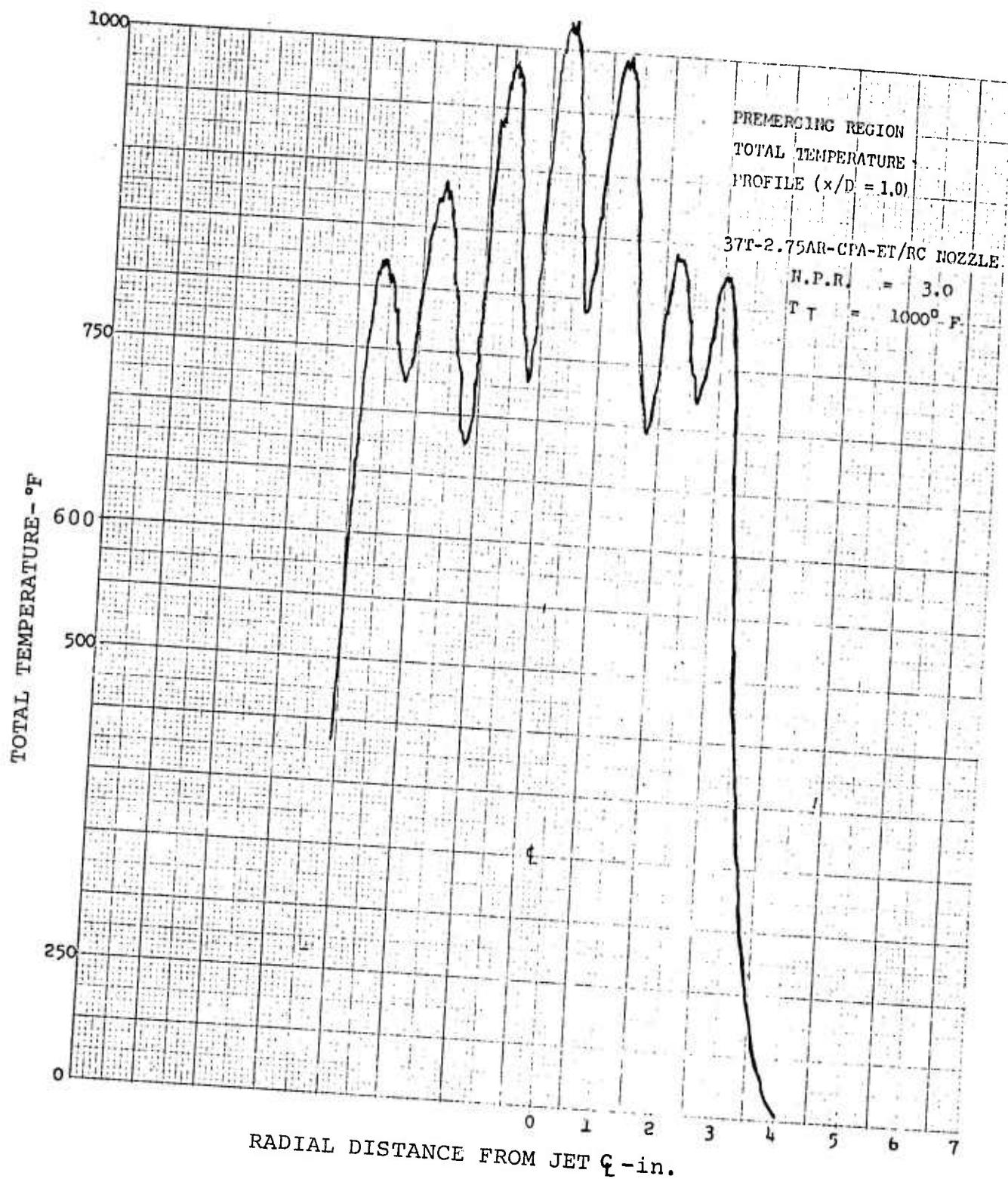


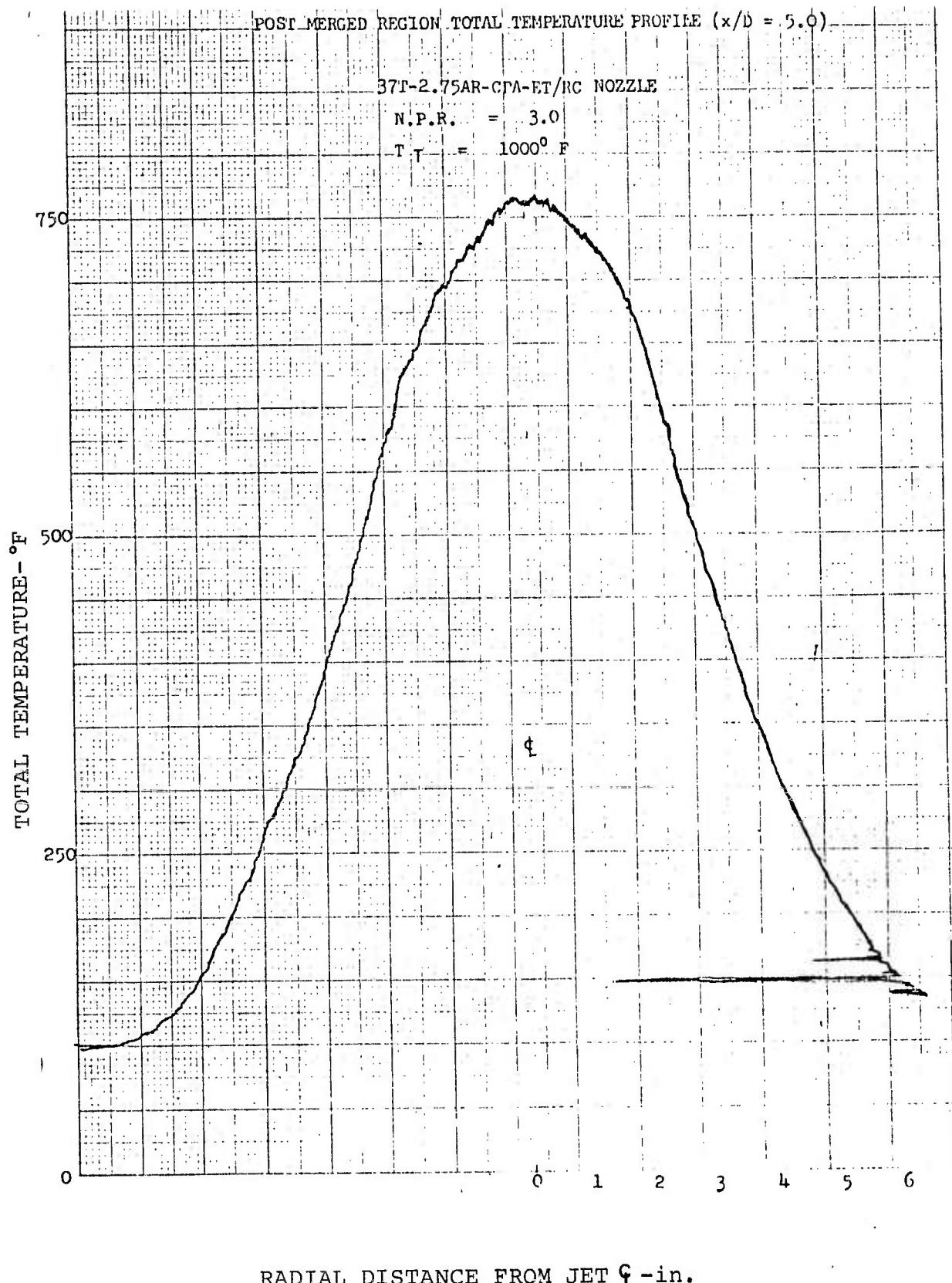


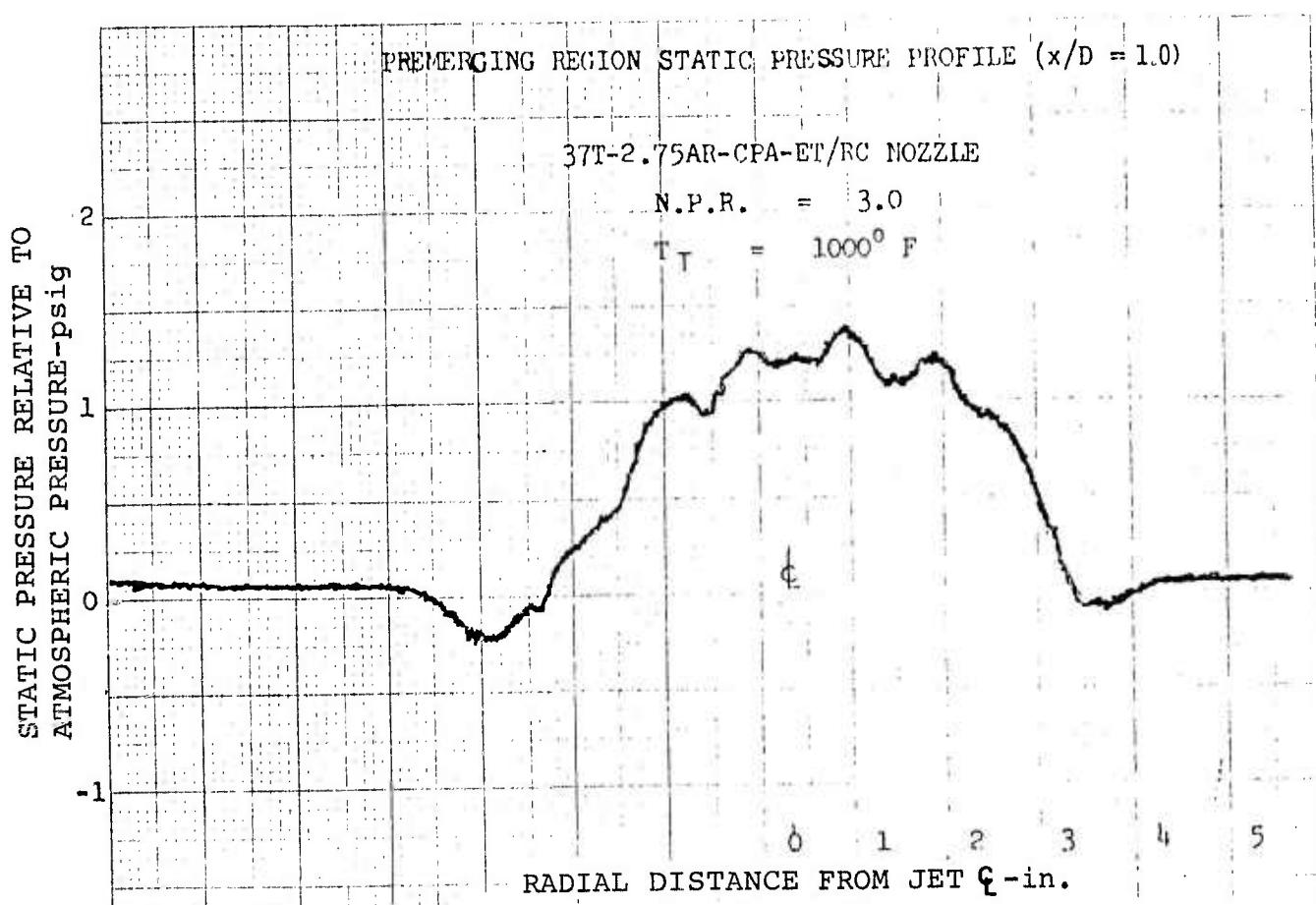


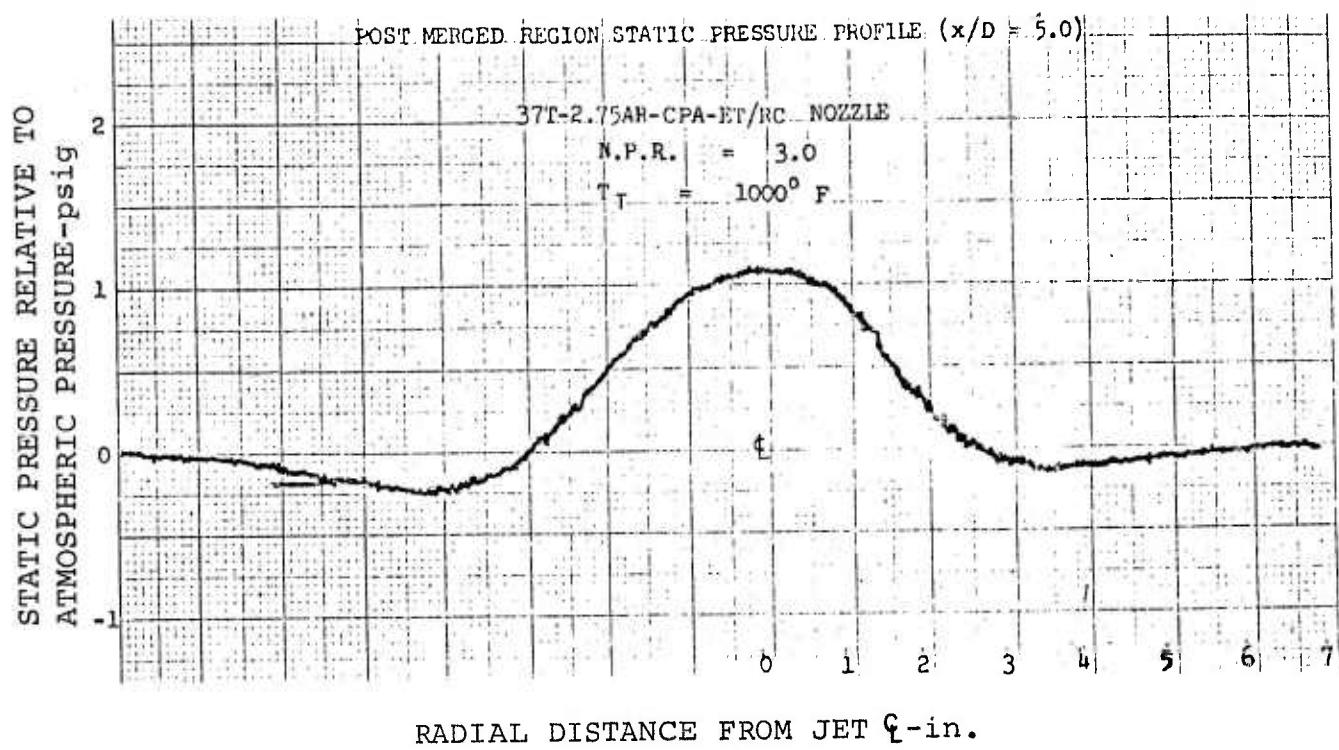


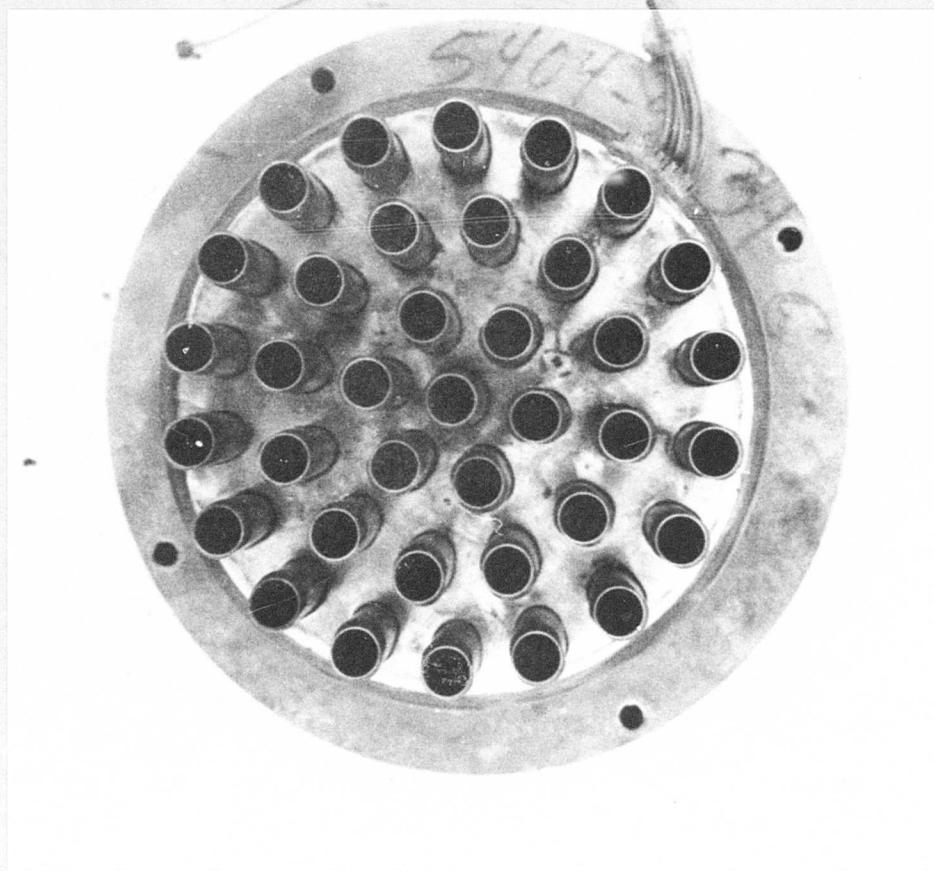








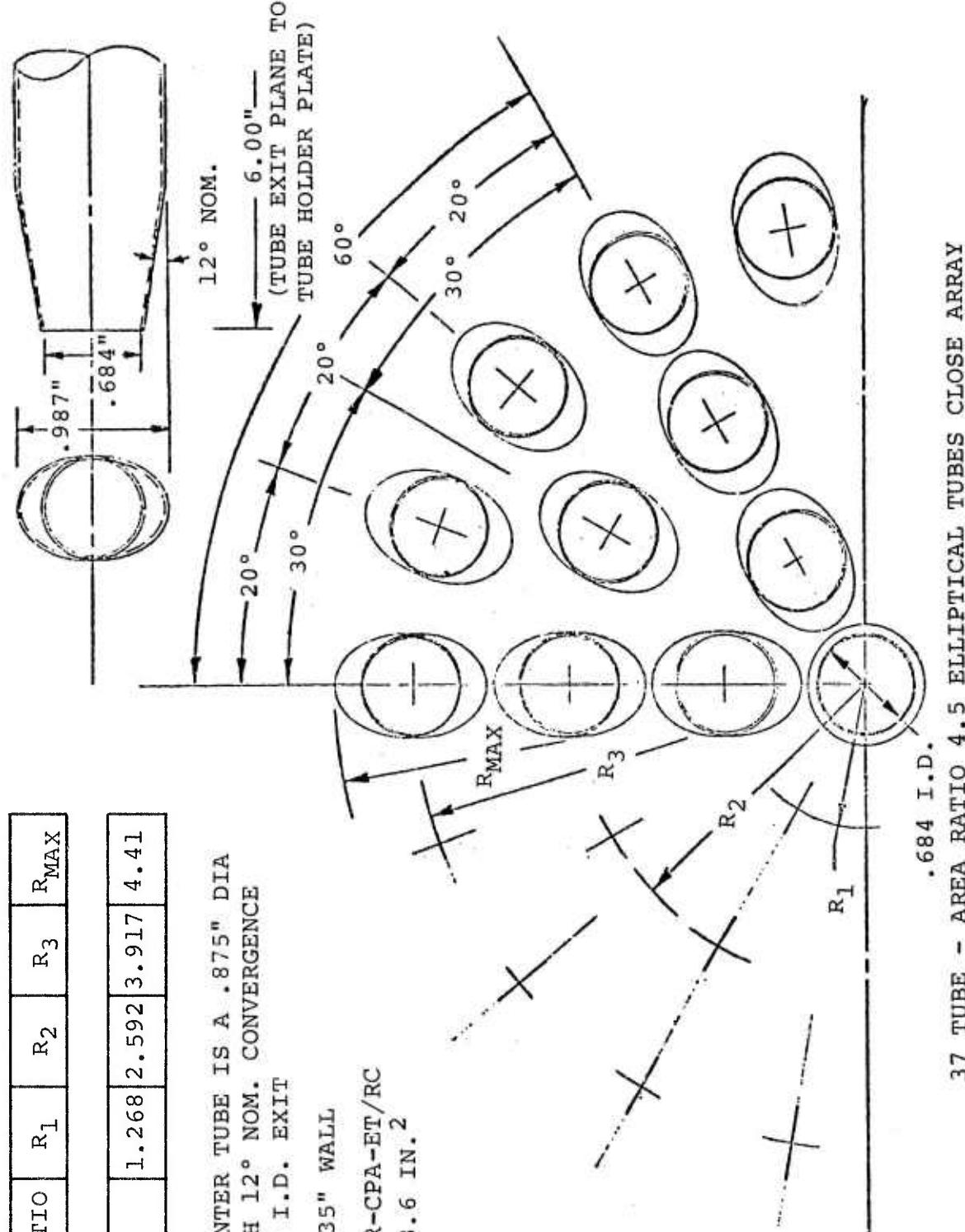




37T-4.5AR-CPA-ET/RC NOZZLE

AREA RATIO	R ₁	R ₂	R ₃	R _{MAX}
4.5	1.268	2.592	3.917	4.41

NOTE: CENTER TUBE IS A .875" DIA
TUBE WITH 12° NOM. CONVERGENCE
TO .684" I.D. EXIT
MAT'L-.035" WALL
37T-4.5AR-CPA-ET/RC
 $A_8 = 13.6 \text{ IN.}^2$



37 TUBE - AREA RATIO 4.5 ELLIPTICAL TUBES CLOSE ARRAY

.684 I.D.

TEST CONDITIONS

NOZZLE: 37T-4.5AR-CPA-ET/RC

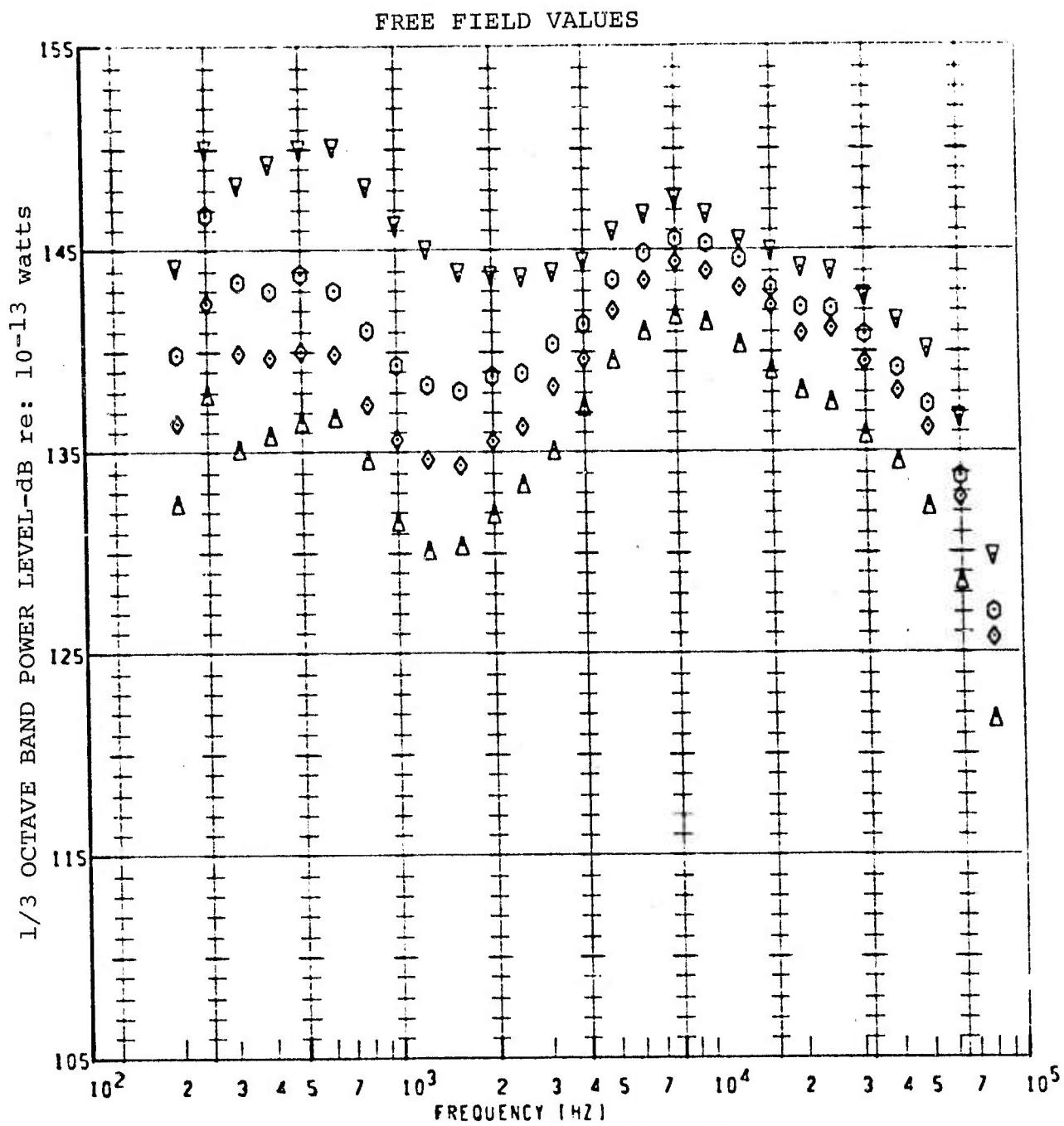
FACILITY: HNTF

DATE: 10-19-73 **T_{AMB}** = 65°F **R.H.** = 62%

SCALE MODEL A₈ = 13.6 in.²

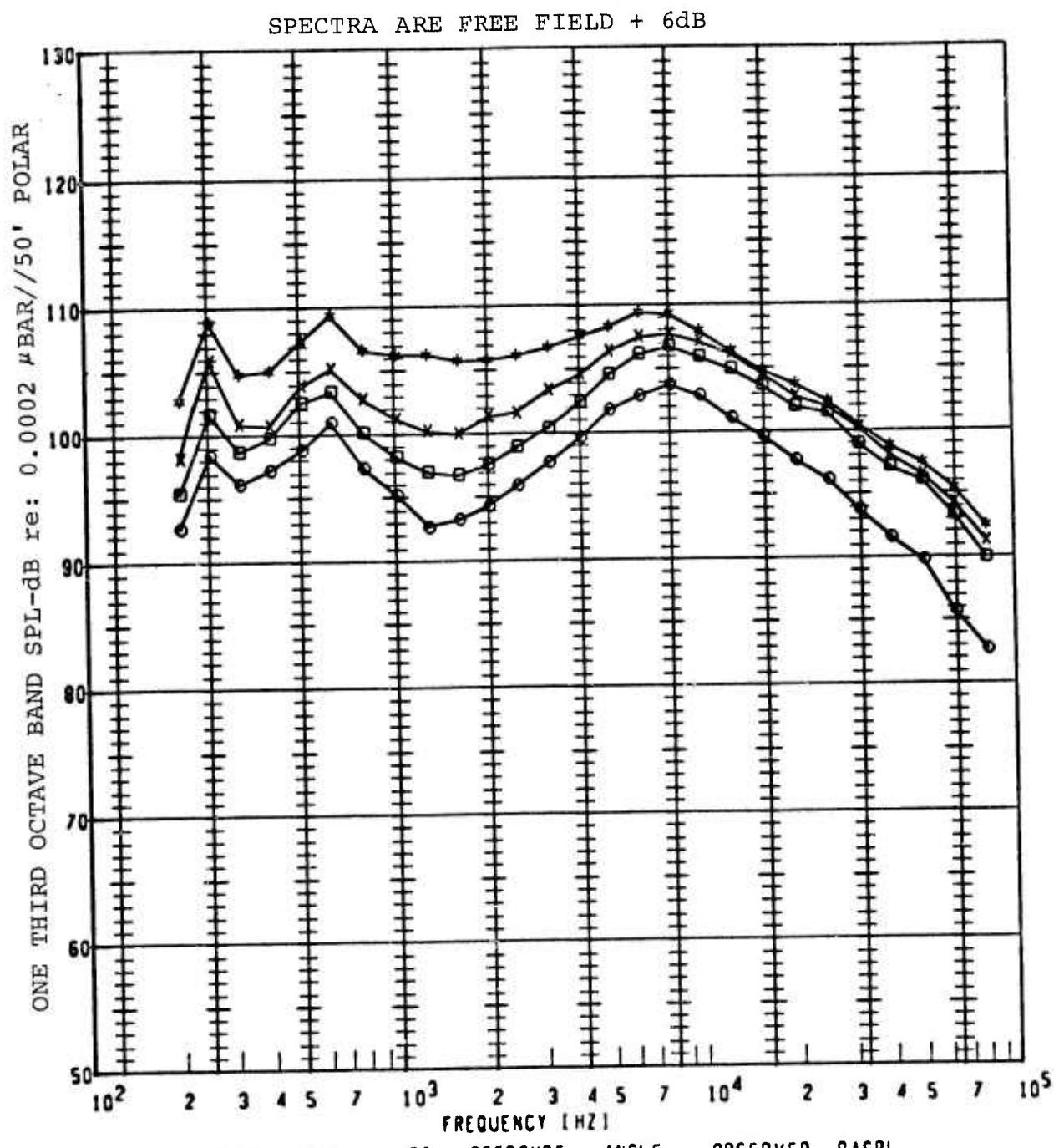
RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
190	2.0	1150°F	1875 fps	3" tube lengths	
"	2.5	"	2126		
"	3.0	"	2303		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



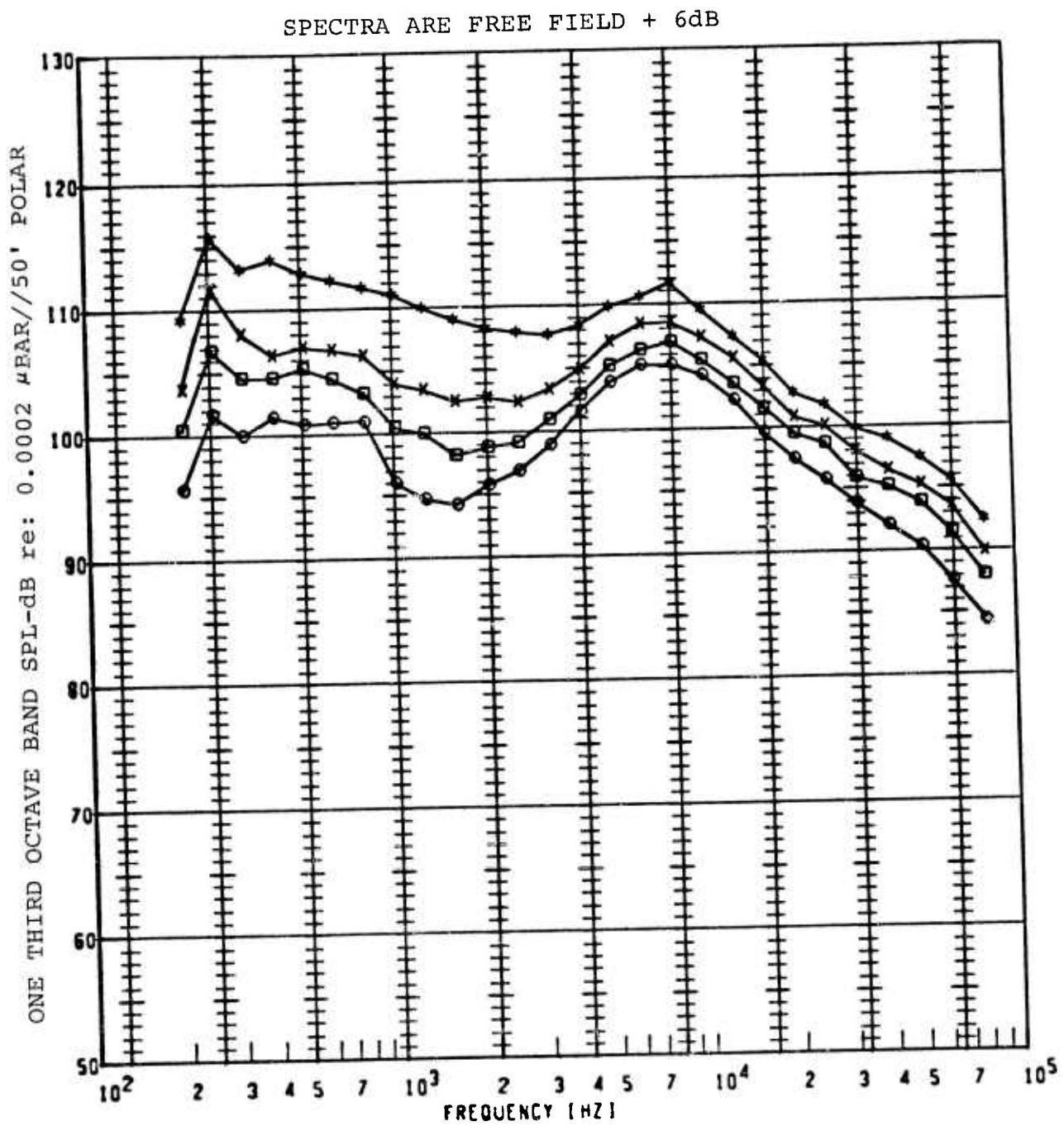
NOZZLE: 37T-4.5AR-CPA-ET/RC

JET NOISE POWER SPECTRA



NOZZLE: 37T-4.5AR-CPA-ET/RC

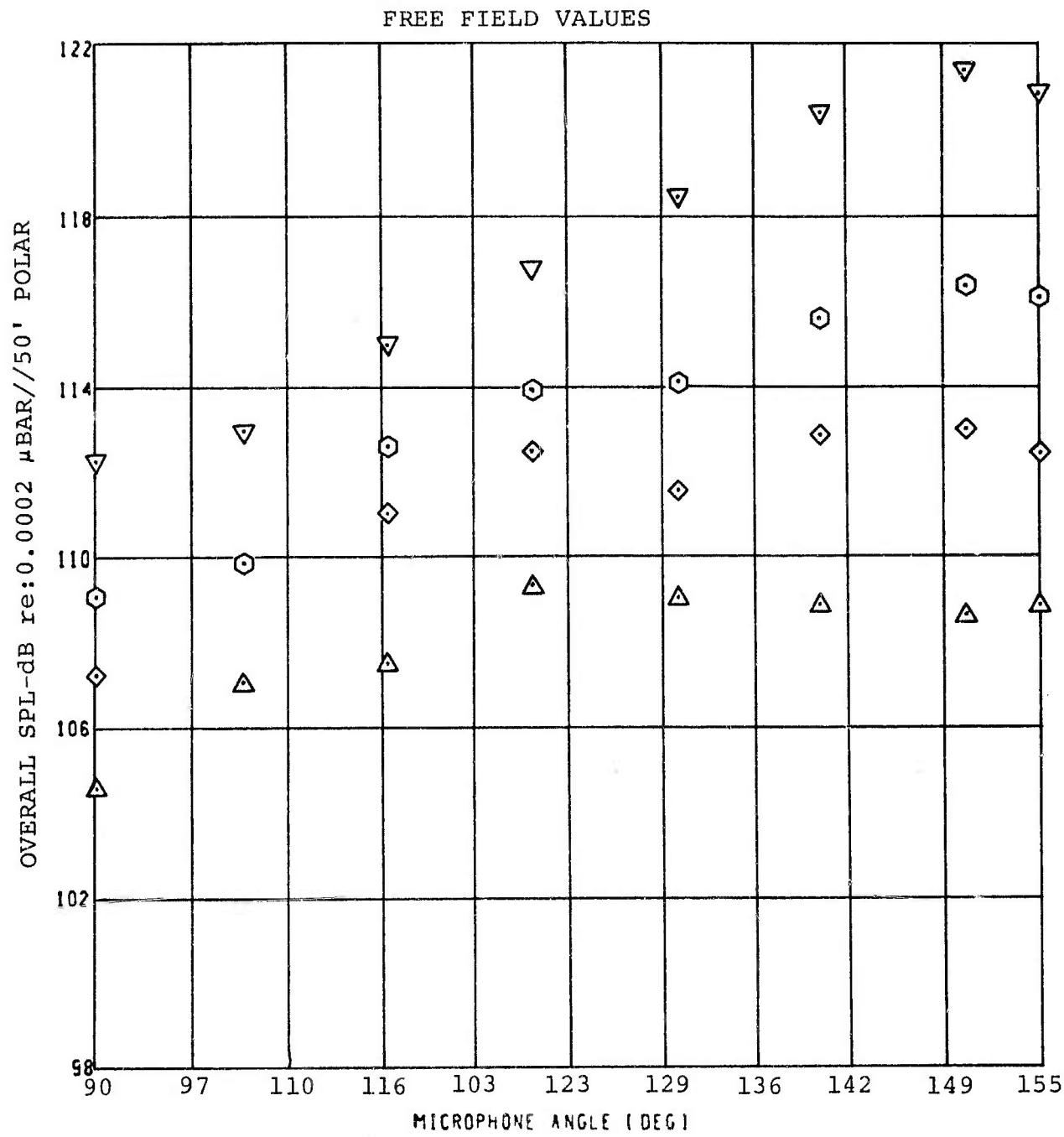
MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	SPL [dB]
○	190G	1150°F	2.000	130°	SOFP	114.4
□	190G	1150	2.500		SOFP	117.0
×	190G	1150	3.000		SOFP	119.6
*	190G	1150	4.000		SOFP	124.1

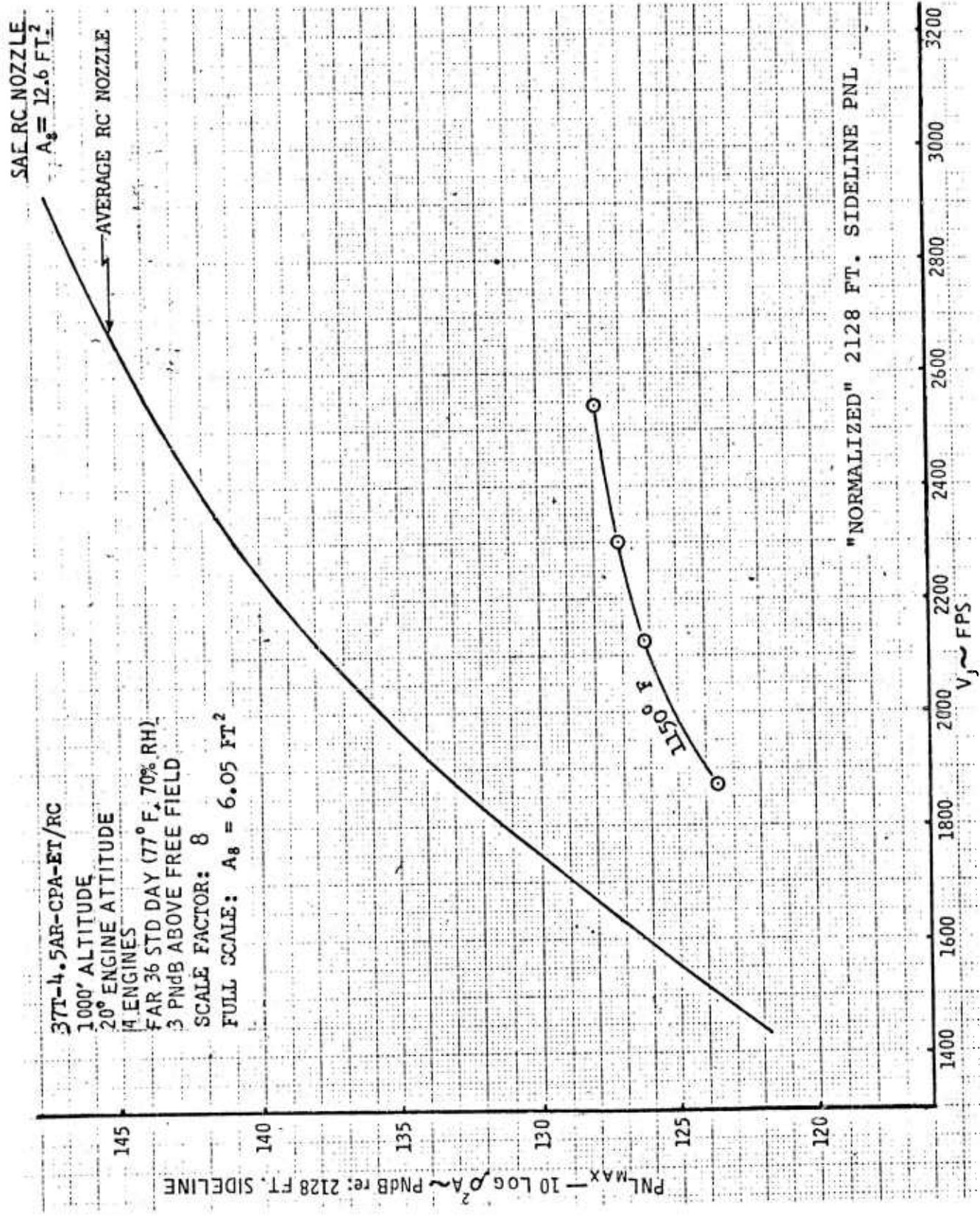
NOZZLE: 37T-4.5AR-CPA-ET/RC

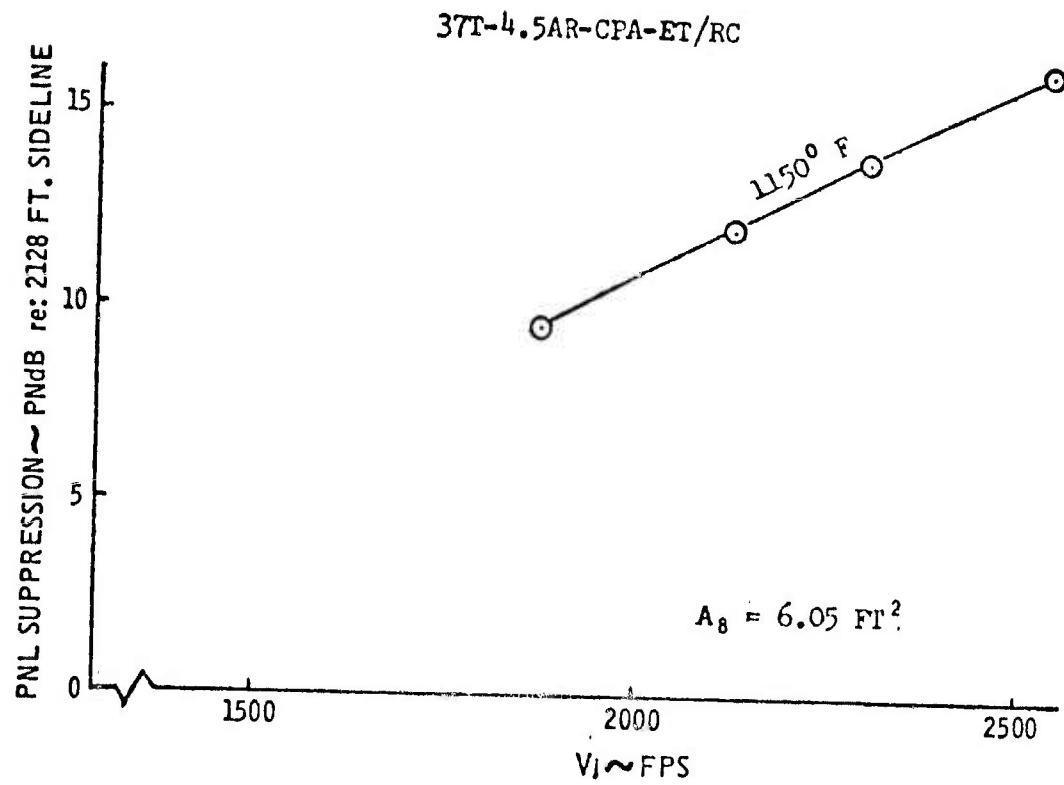
MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



NOZZLE: 37T-4.5AR-CPA-ET/RC

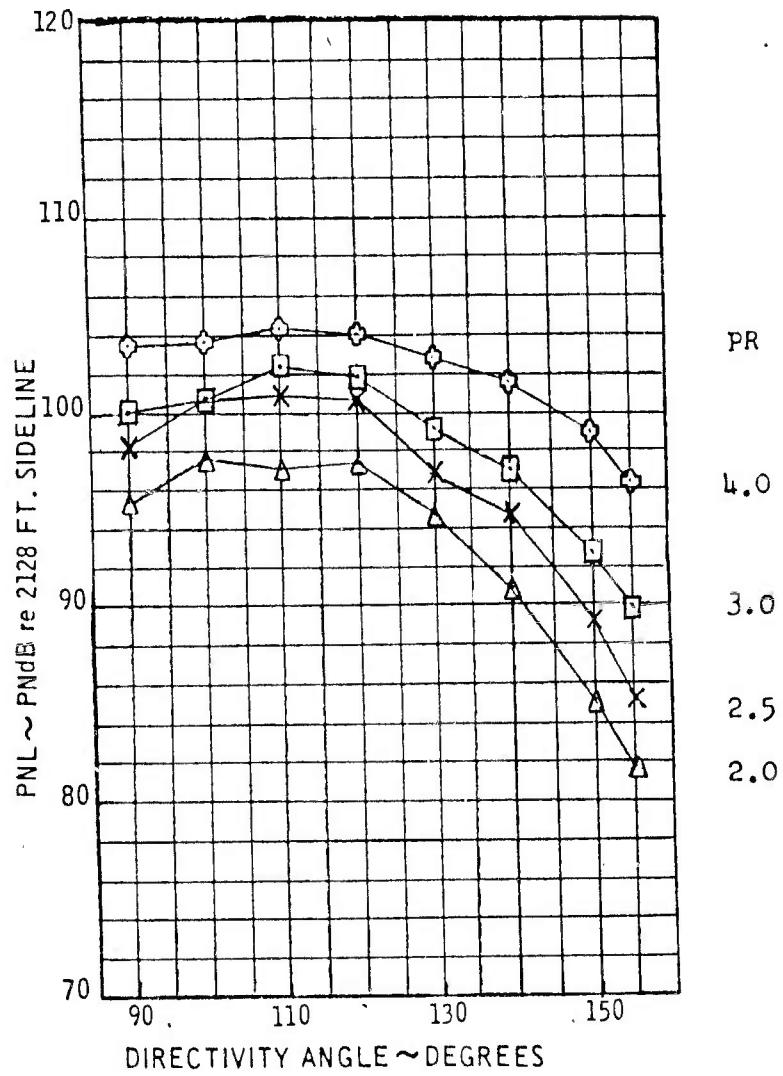
OASPL BEAM PATTERNS





PEAK PNL SUPPRESSION VALUES

NOZZLE: 37T-4.5AR-CPA-ET/RC

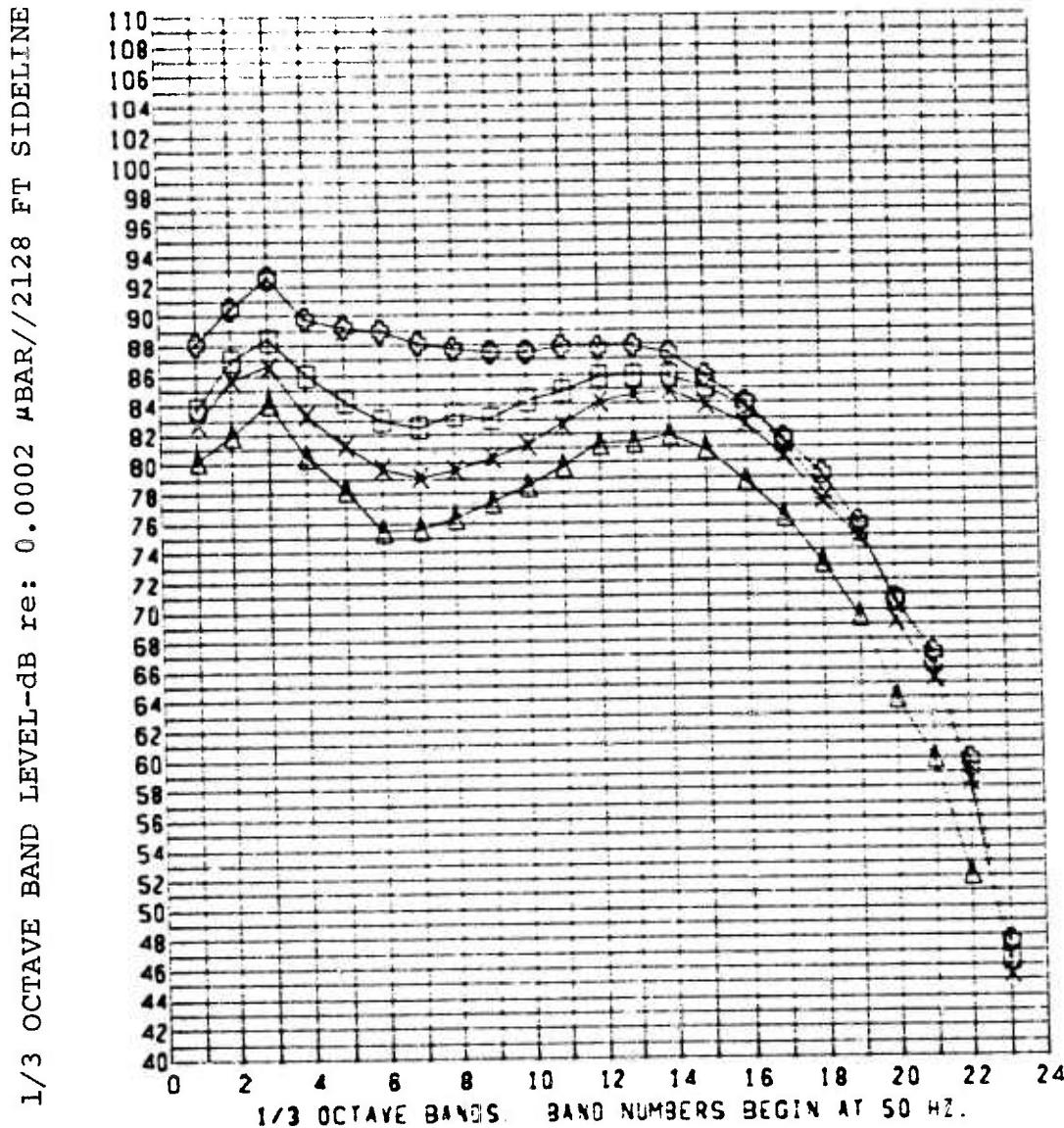


RUN 190
TT = 1150° F A8 = 6.05 FT²

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



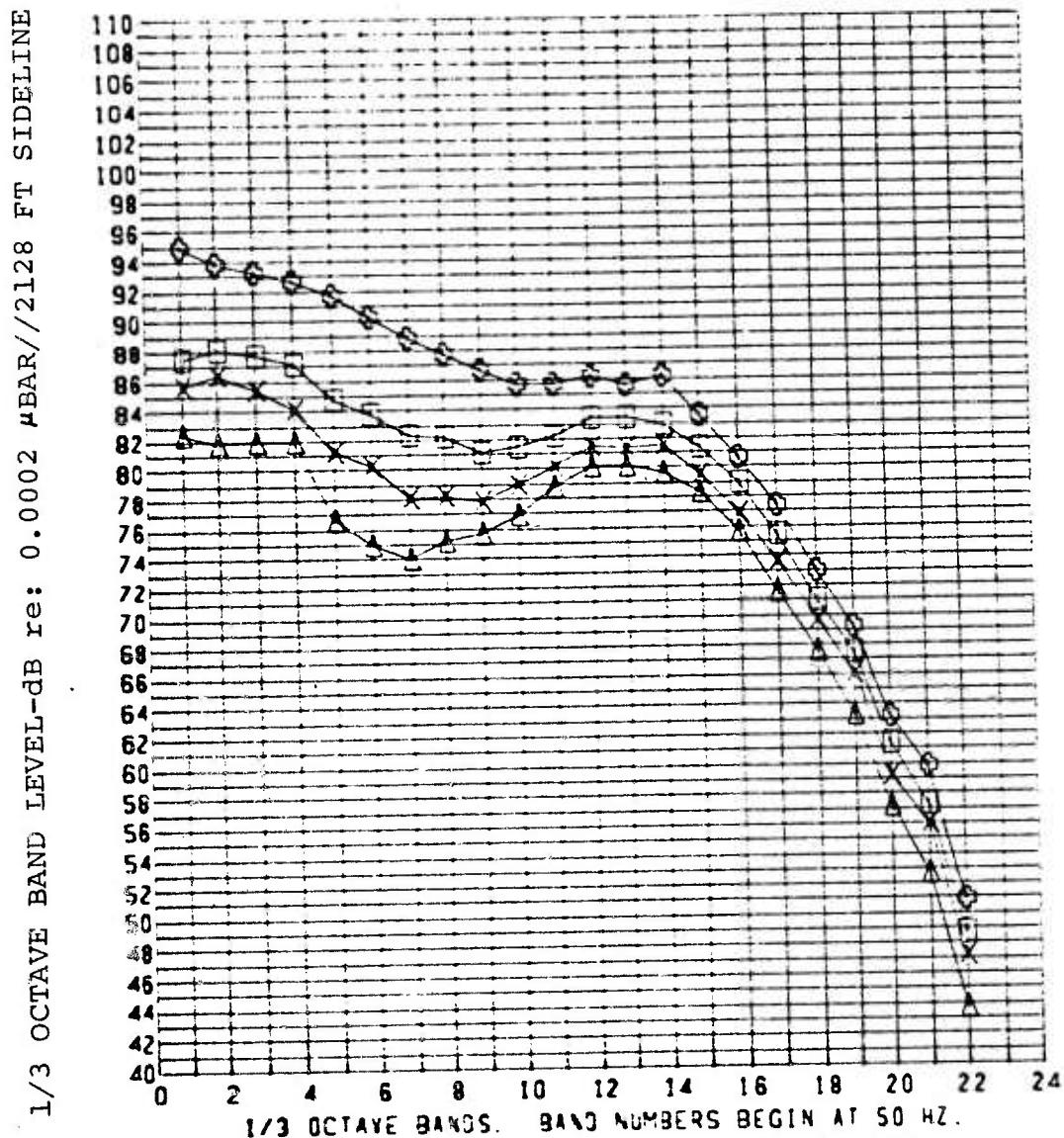
NOZZLE: 37T-4.5AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°

re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 190

PR = Δ 2.0, X 2.5, □ 3.0, + 4.0

NOZZLE: 37T-4.5AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°
re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 37T-4.5AR-CPA-ET/RC

FACILITY: WALL ISOLATION FACILITY

DATE: January 16, 1973

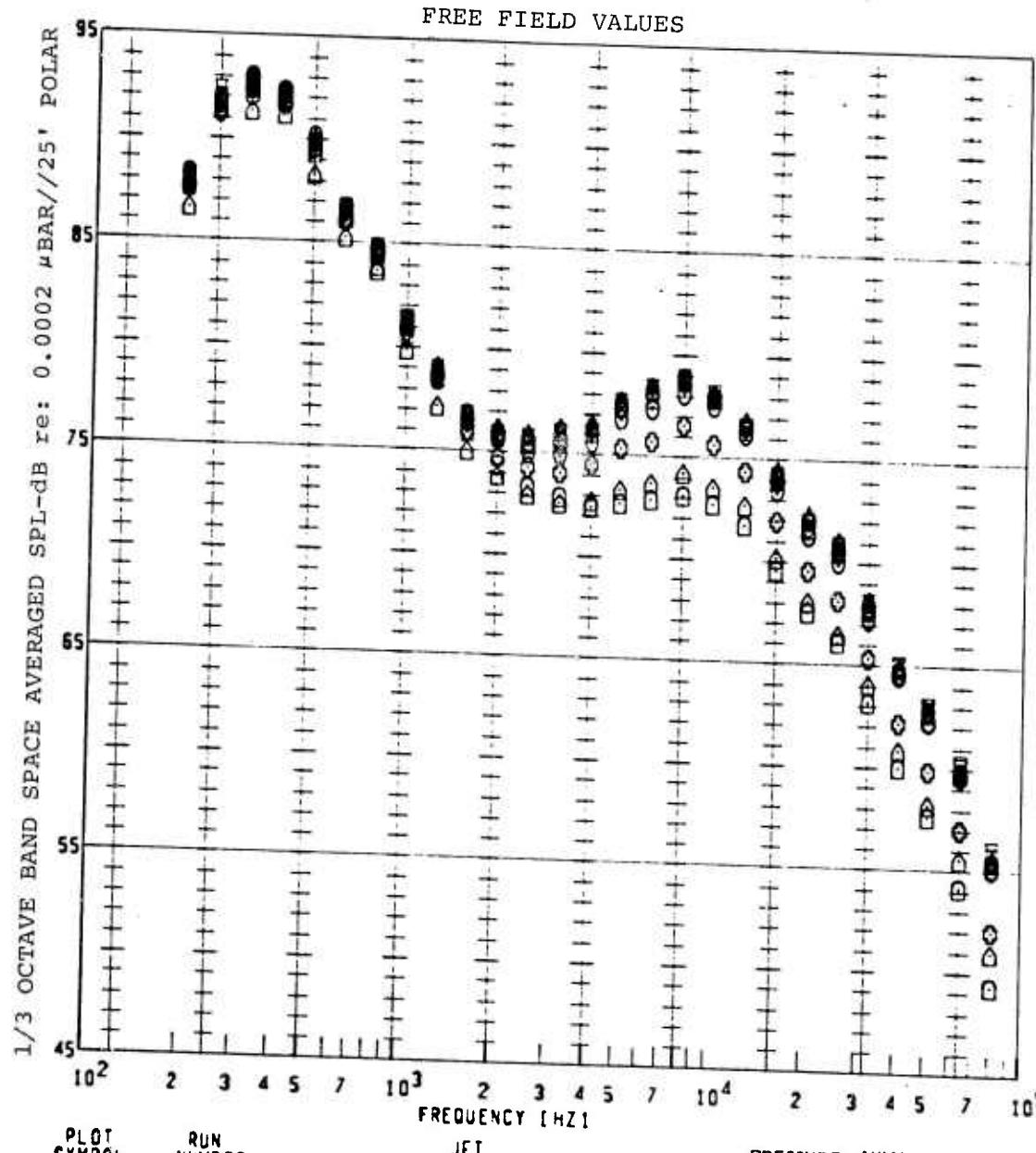
P_{AMB} = 29.34 in Hg **T_{AMB}** = 46°F **R.H.** = 91%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

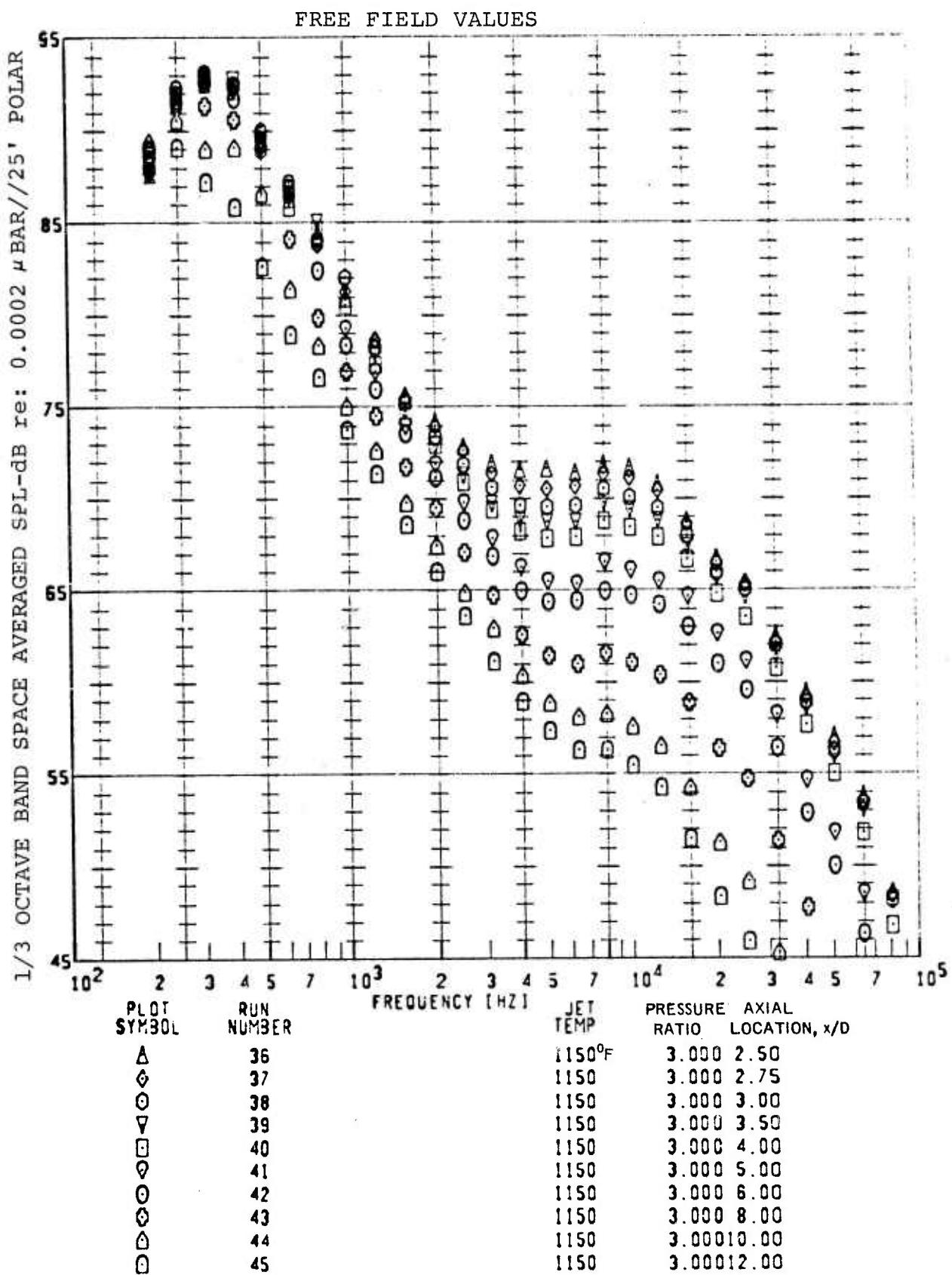
SCALE MODEL A₈ = 13.6 in.²

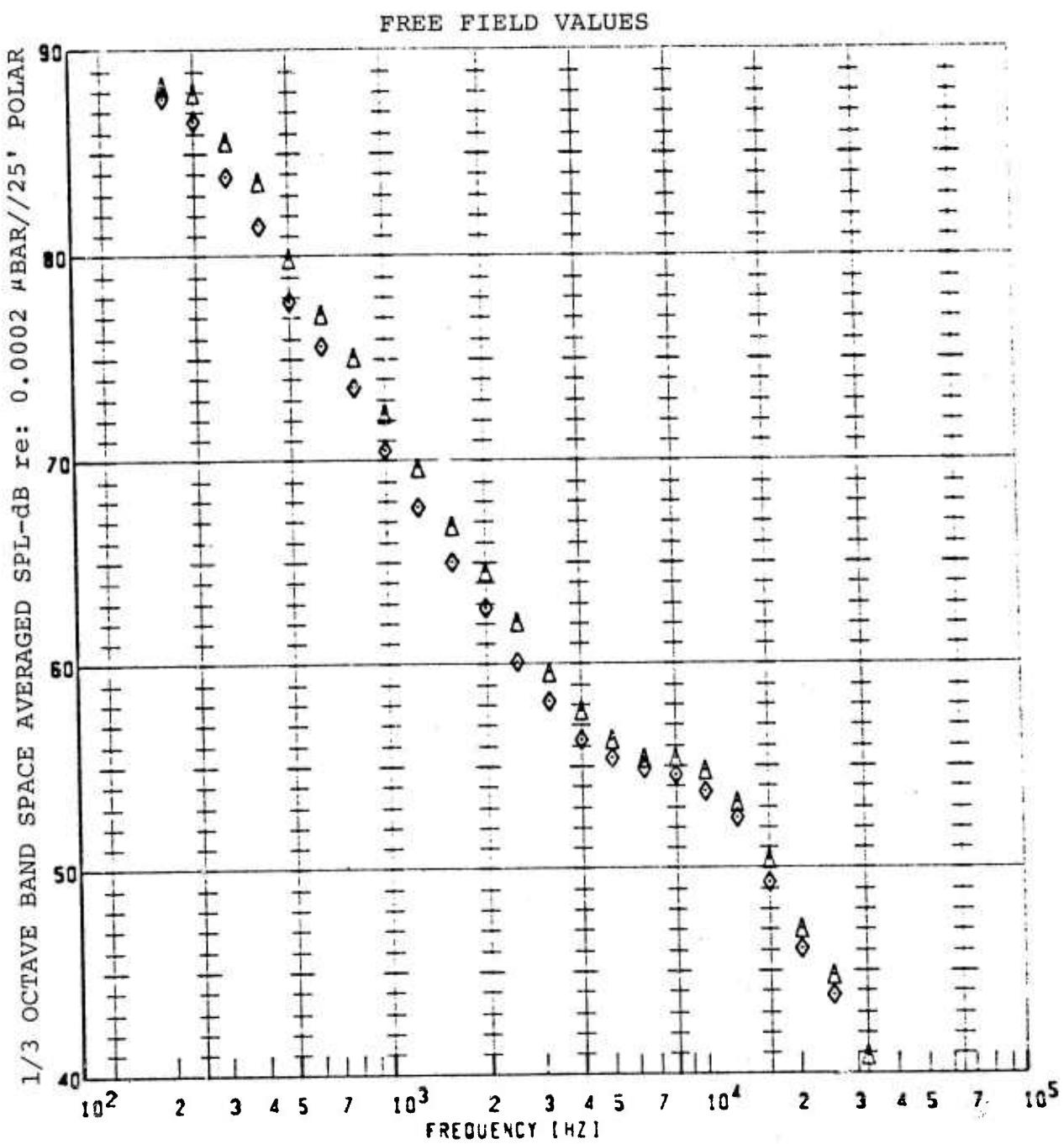
RUN NO.	AXIAL LOCATION	IRIS DIA.	REMARKS	REF.
26	0.0 x/D	11.0 in.		
27	0.25	12.0		
28	0.50	12.5		
29	0.75	12.5		
30	1.00	15.0		
31	1.25	13.0		
32	1.50	12.0		
33	1.75	12.5		
34	2.00	12.5		
35	2.25	13.0		
36	2.50	13.0		
37	2.75	13.5		
38	3.0	14.5		
39	3.5	14.0		
40	4.0	14.5		
41	5.0	16.5		
42	6.0	16.5		
43	8.0	18.0		
44	10.0	20.0		
45	12.0	22.0		
46	14.0	24.0		
47	16.0	24.0		

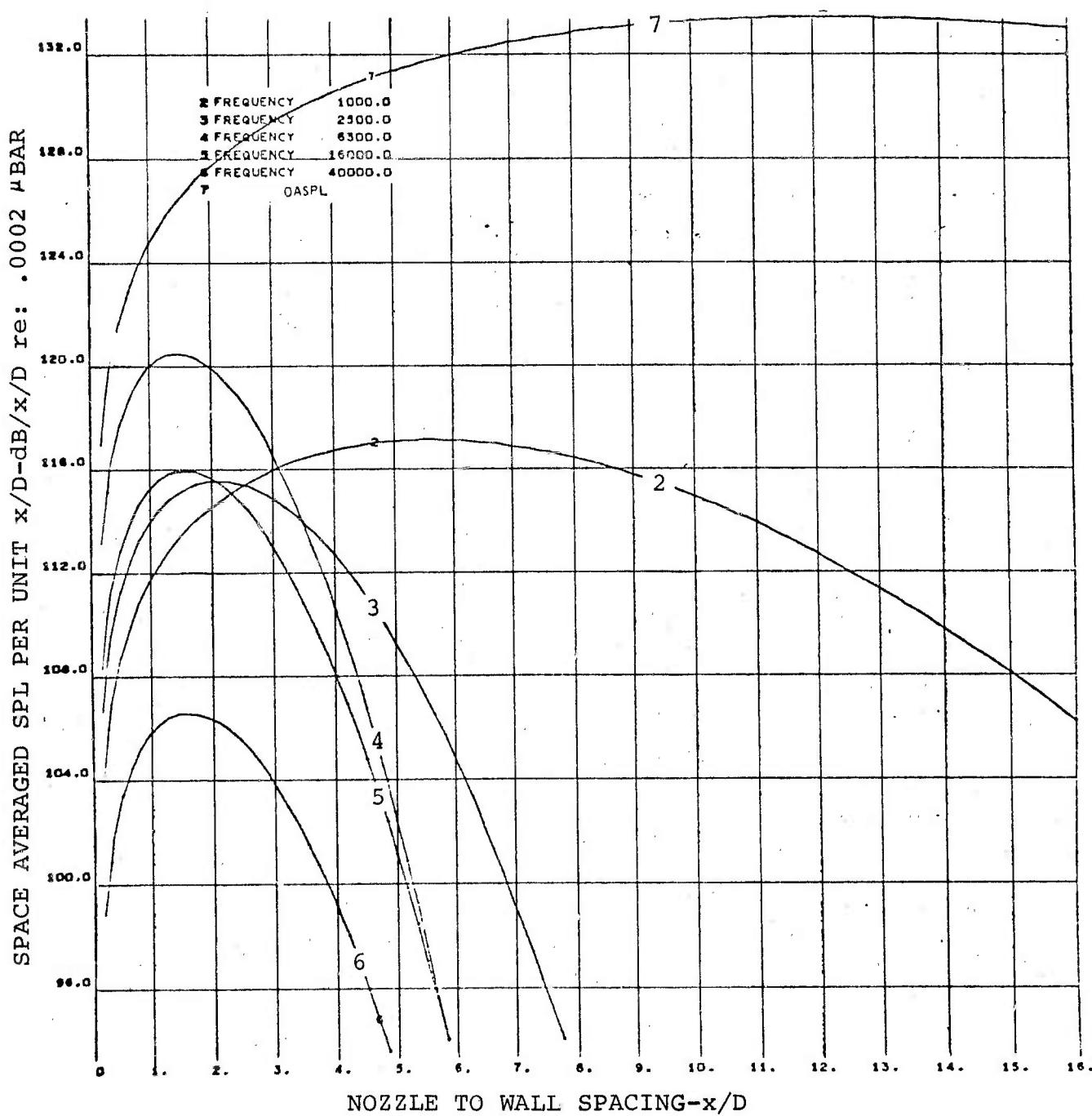
MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

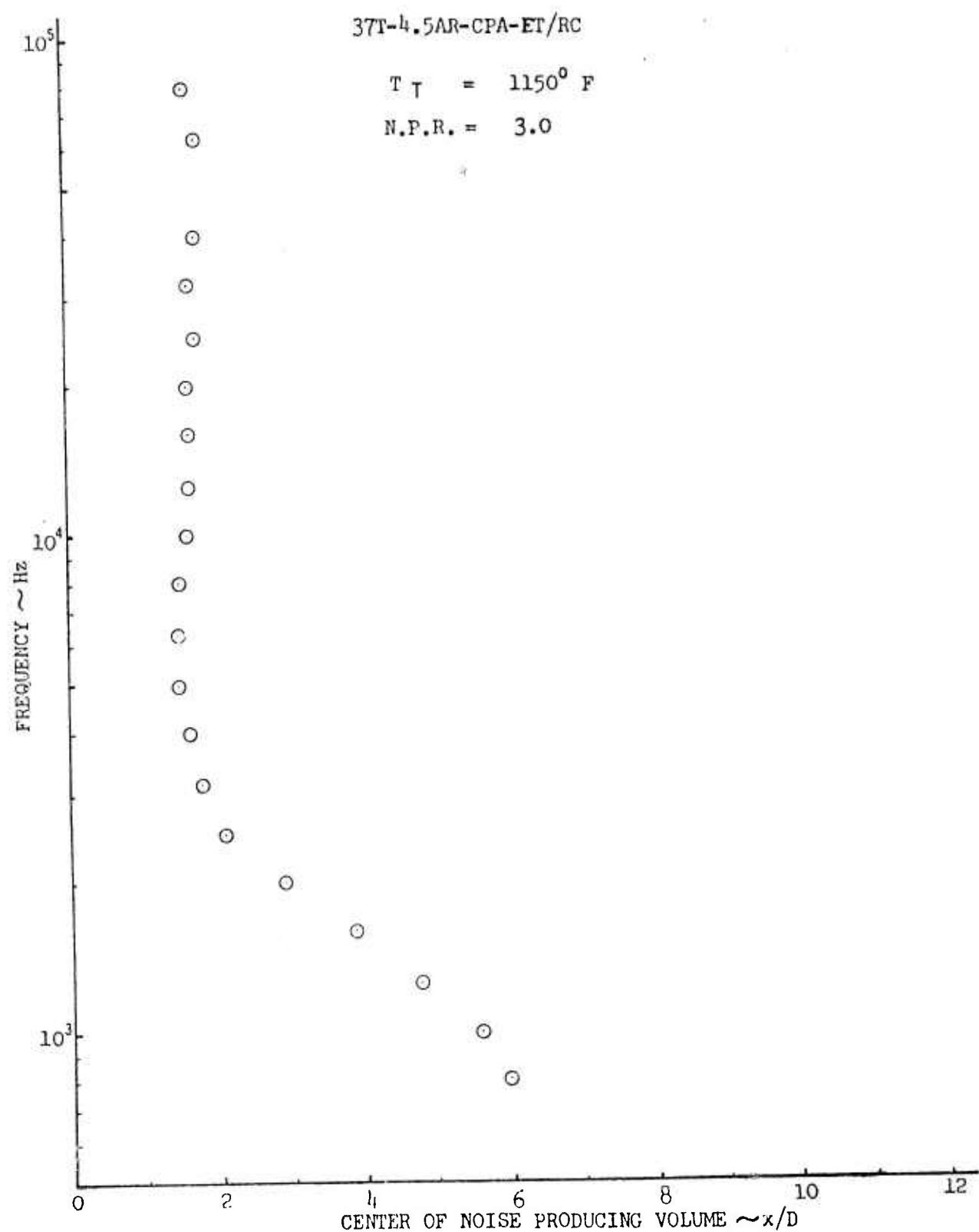


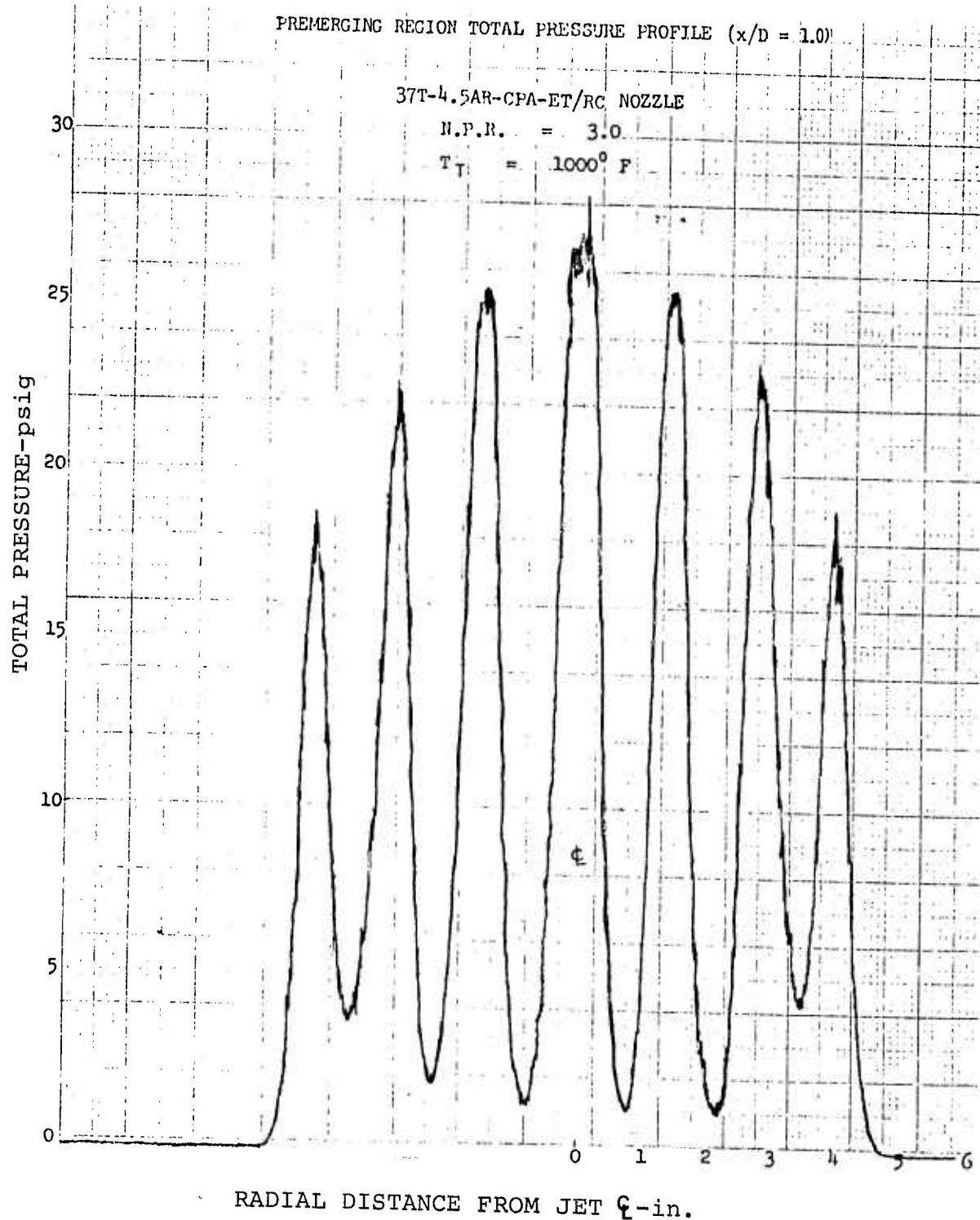
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	26	1150°F	3.0	0.00
◊	27	1150	3.0	0.25
○	28	1150	3.0	0.50
□	29	1150	3.0	0.75
▽	30	1150	3.0	1.00
○	31	1150	3.0	1.25
□	32	1150	3.0	1.50
○	33	1150	3.0	1.75
□	34	1150	3.0	2.00
○	35	1150	3.0	2.25









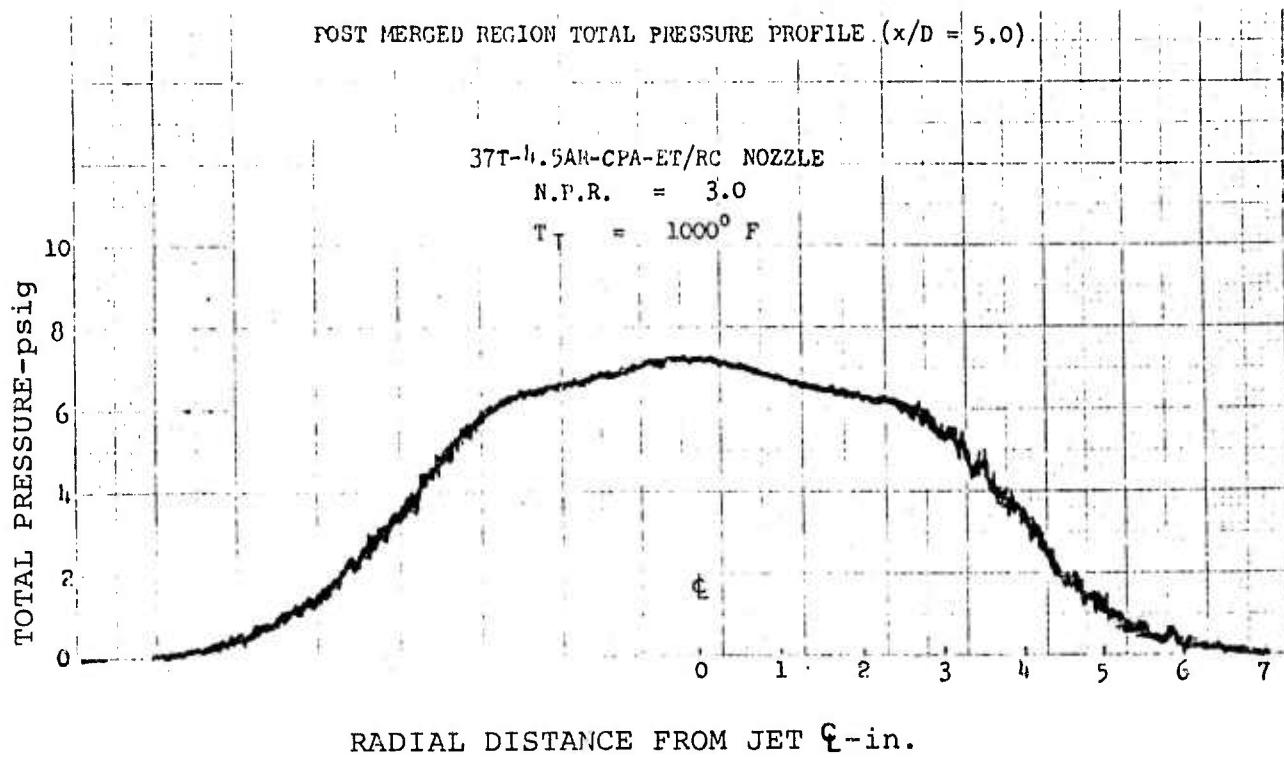


POST MERGED REGION TOTAL PRESSURE PROFILE ($x/D = 5.0$)

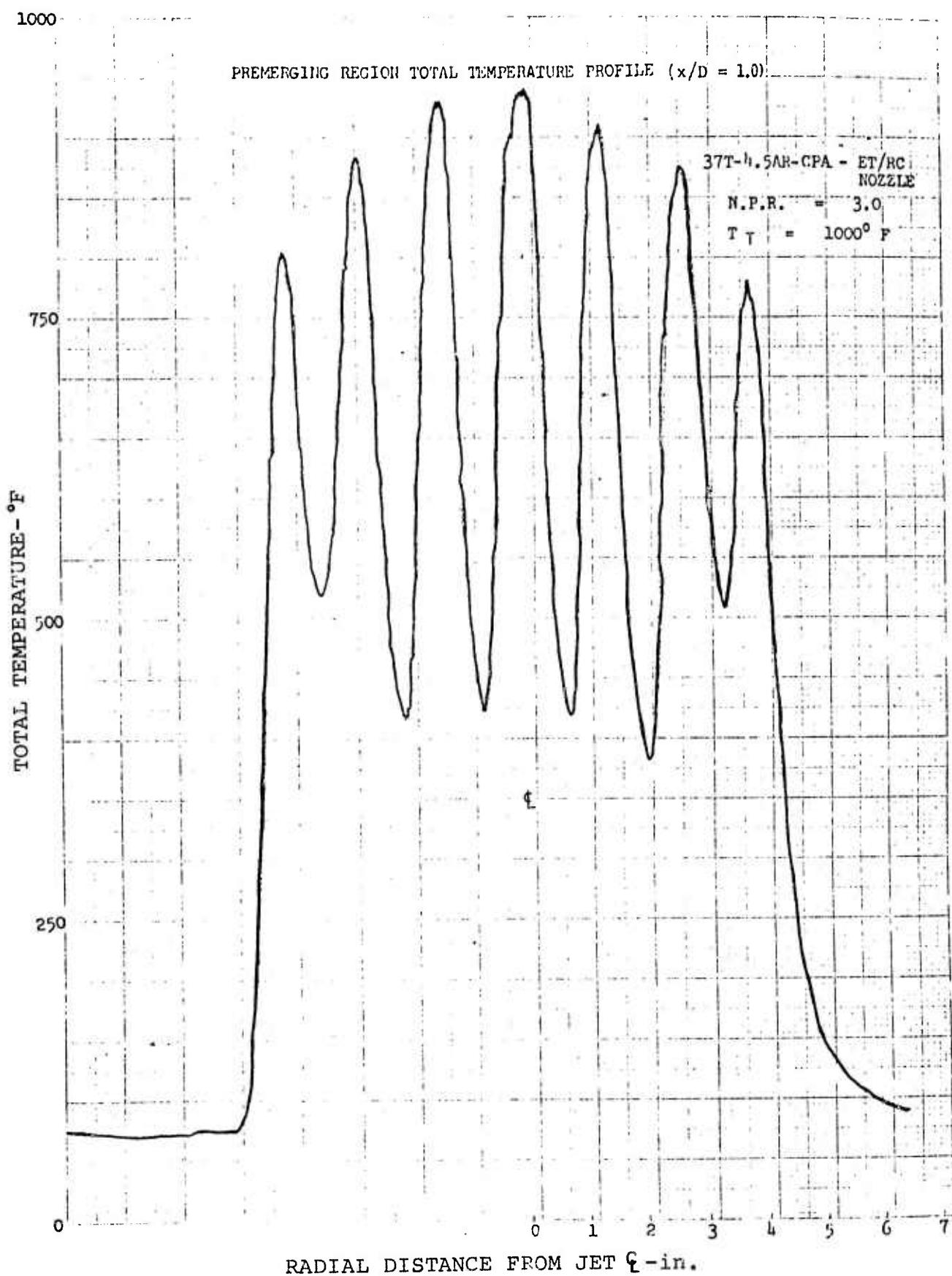
37T-4.5AH-CPA-ET/RC NOZZLE

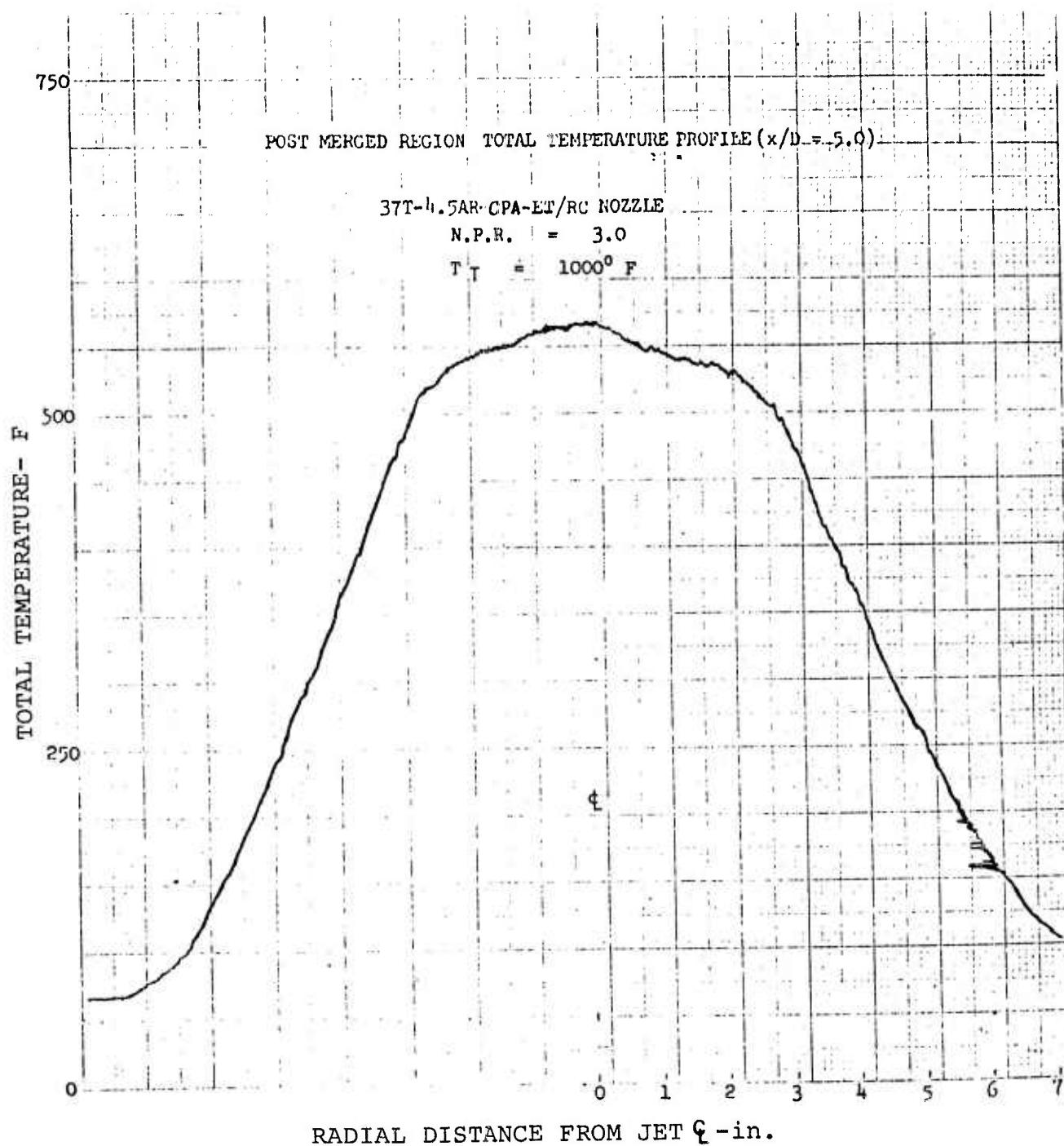
N.P.R. = 3.0

T_T = 1000° F

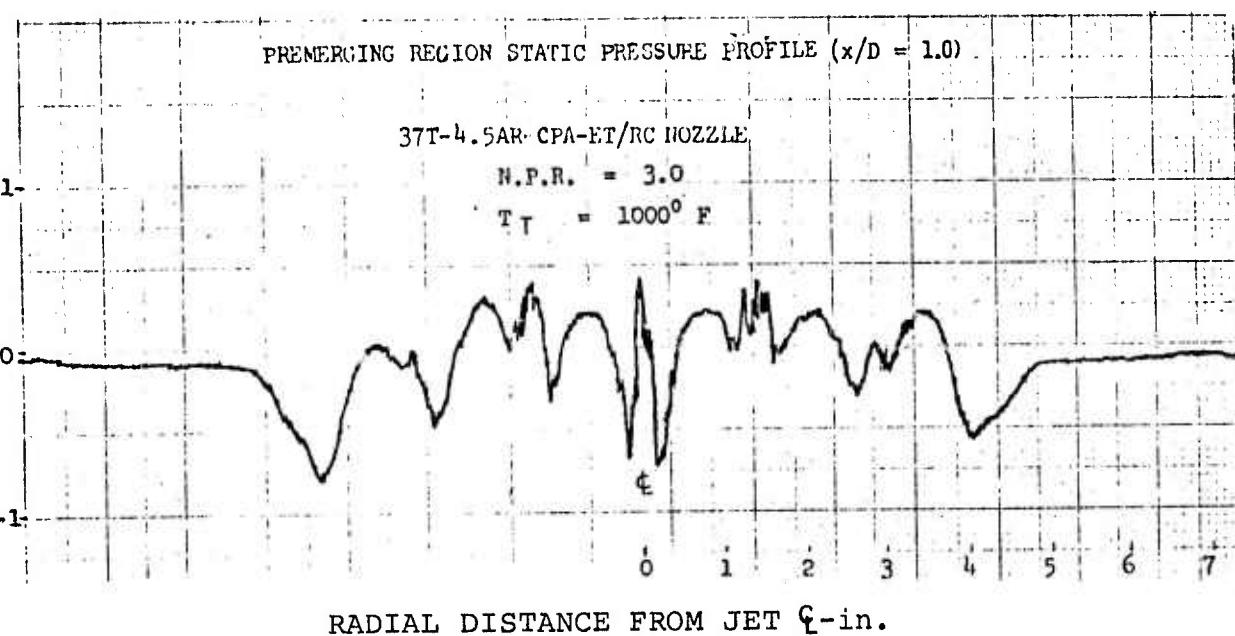


RADIAL DISTANCE FROM JET ξ -in.

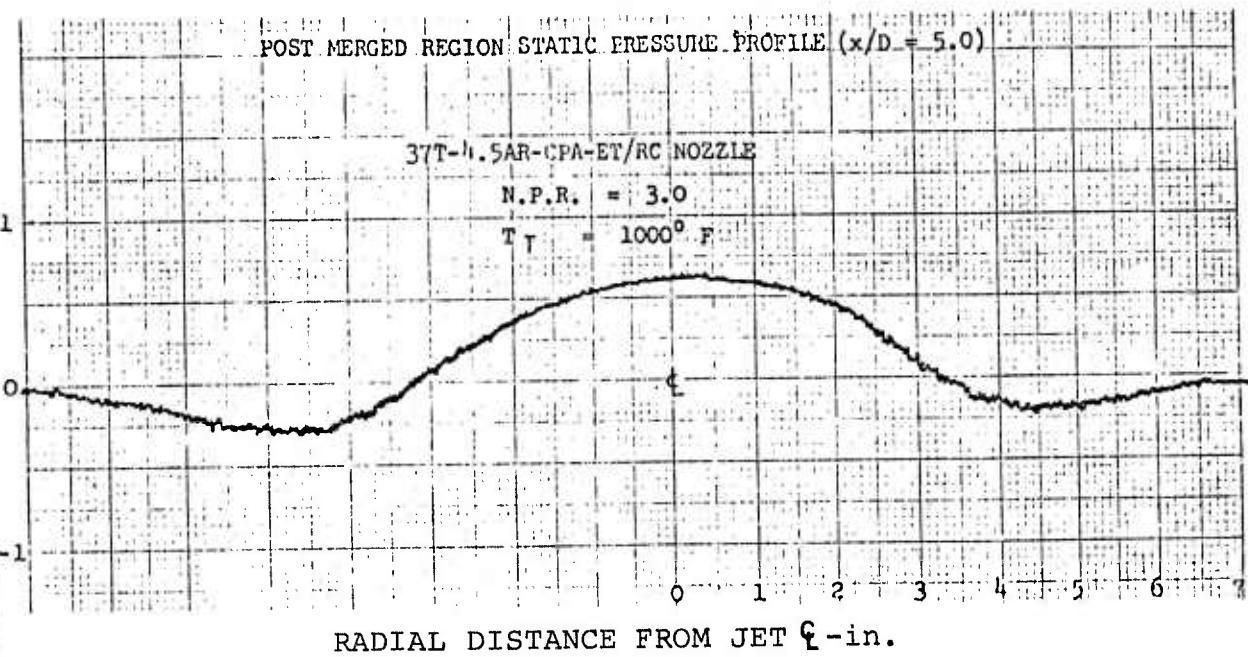




STATIC PRESSURE RELATIVE TO ATMOSPHERIC PRESSURE-psig

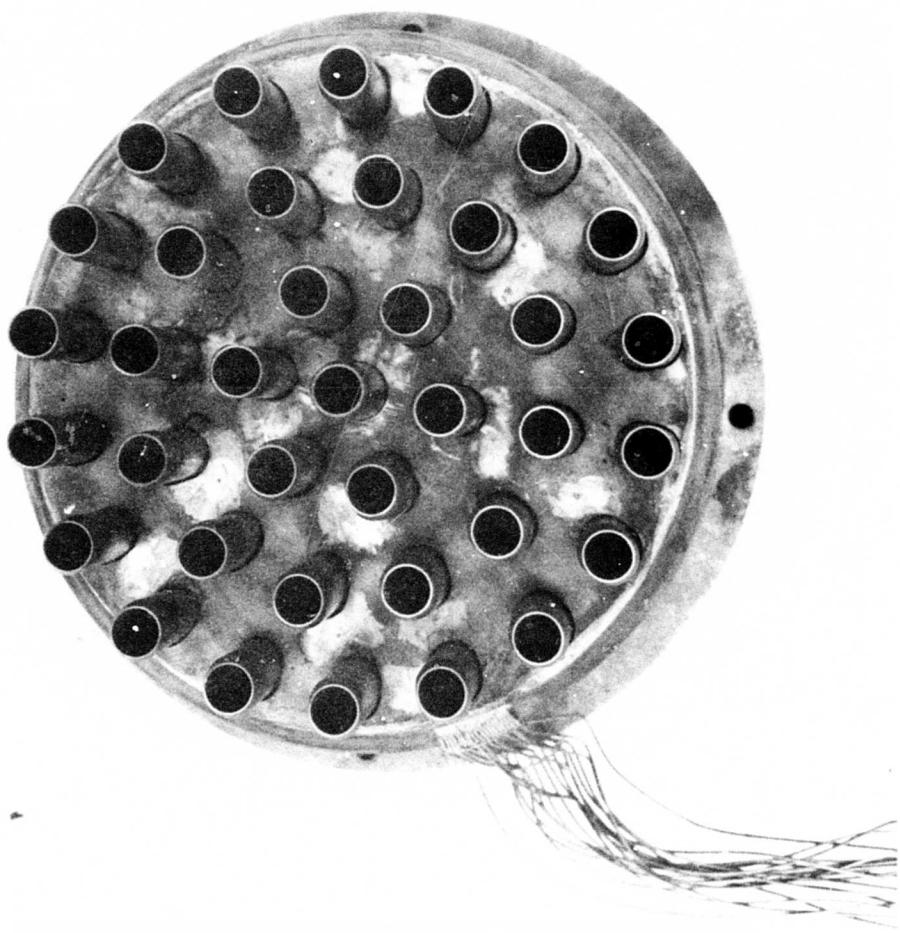


STATIC PRESSURE RELATIVE TO ATMOSPHERIC PRESSURE-psig





37T-6.0AR-CPA-ET/RC NOZZLE

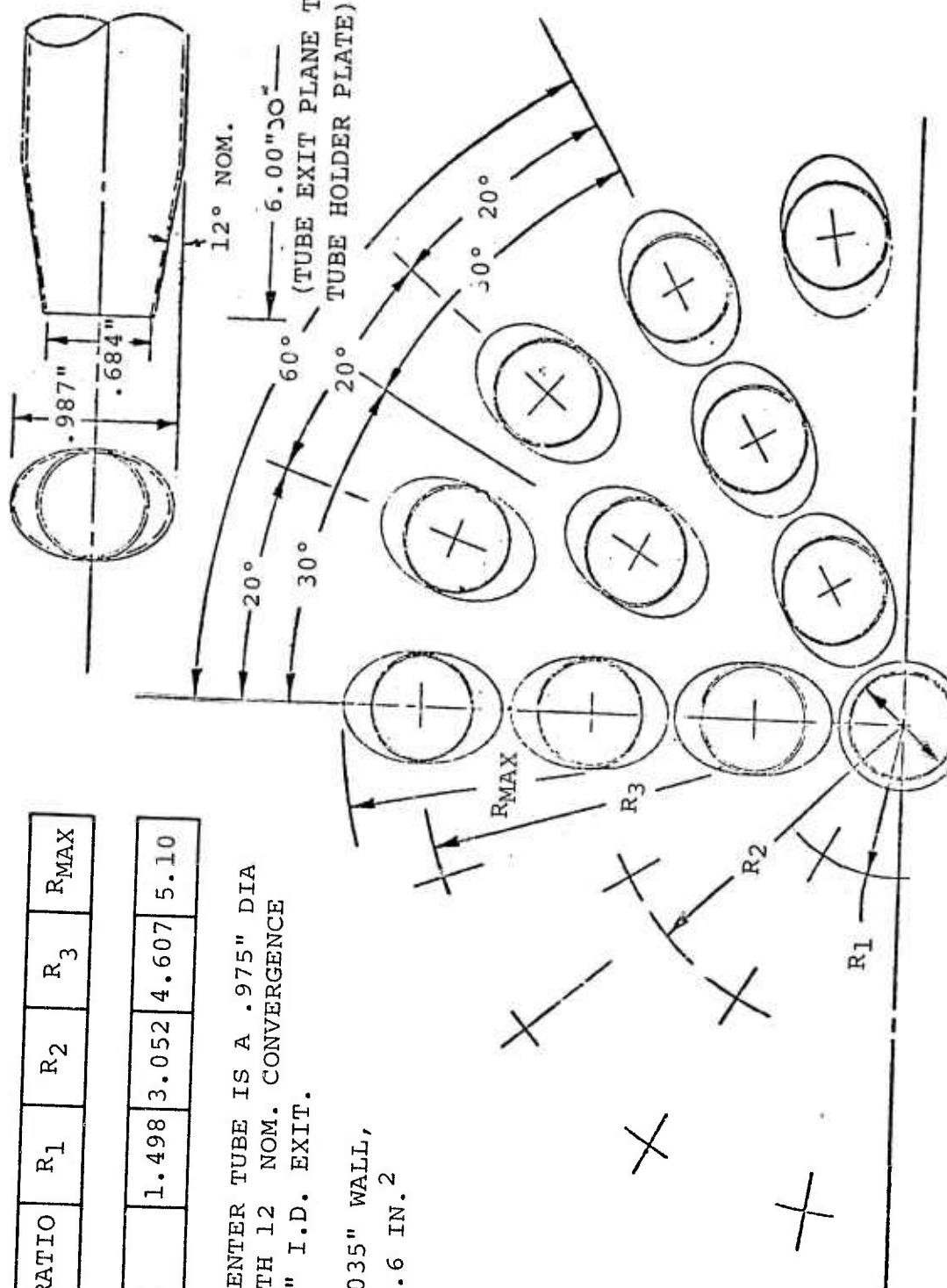


37T-6.0AR-CPA-ET/RC NOZZLE

AREA RATIO	R ₁	R ₂	R ₃	R _{MAX}
6.0	1.498	3.052	4.607	5.10

NOTE: CENTER TUBE IS A .975" DIA
TUBE WITH 12 NOM. CONVERGENCE
TO .684" I.D. EXIT.

MAT'L-.035" WALL,
 $A_8 = 13.6 \text{ IN.}^2$



37 TUBE - AREA RATIO 6.0 ELLIPTICAL RUBES CLOSE ARRAY

TEST CONDITIONS

NOZZLE: 37T-6.0AR-CPA-ET/RC

FACILITY: HNTF

DATE: 10-22-73

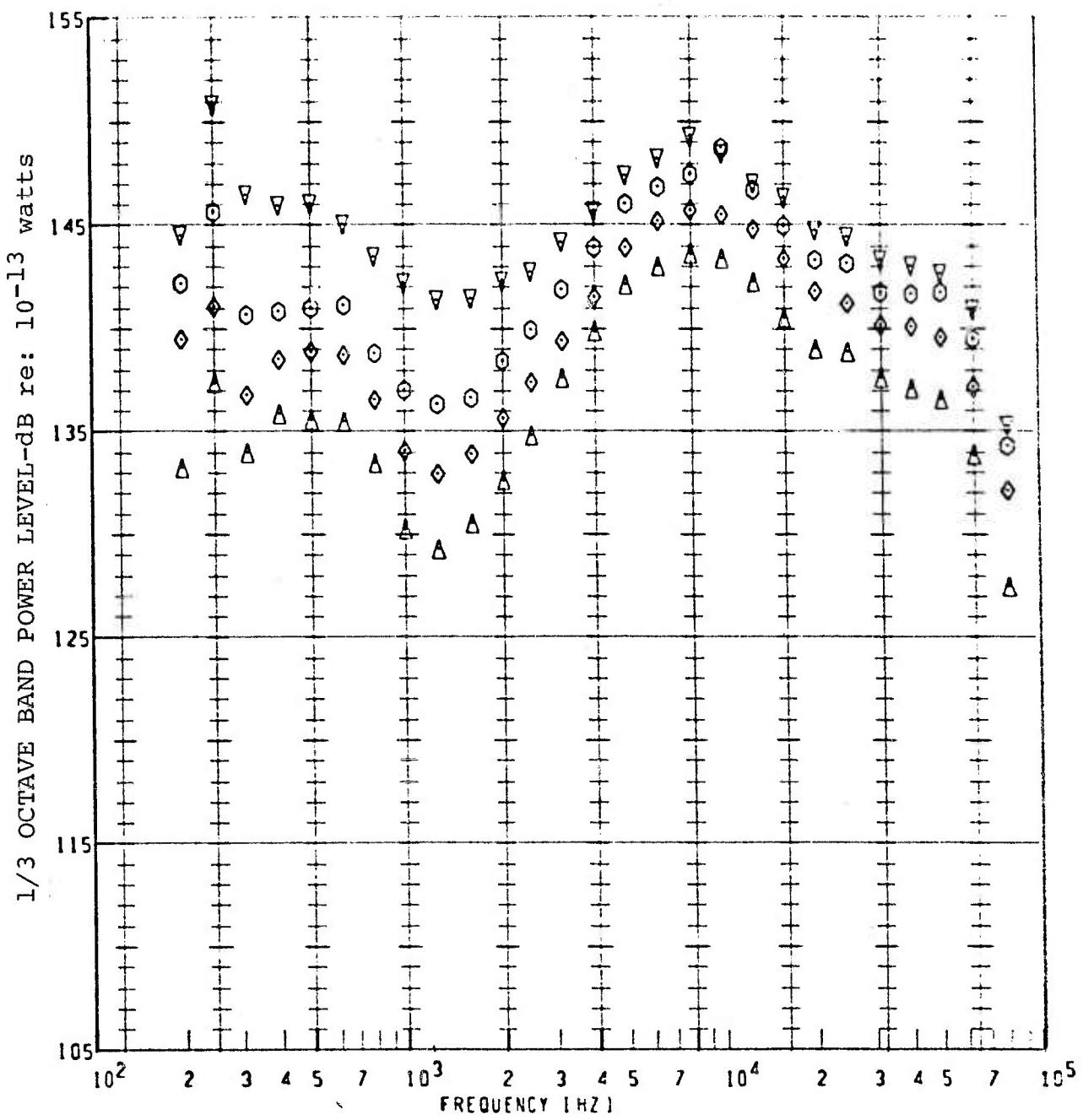
T_{AMB} = 51.5°F R.H. = 87%

SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
193	2.0	1150°F	1875 fps	3" tube lengths	
"	2.5	"	2126		
"	3.0	"	2303		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

FREE FIELD VALUES

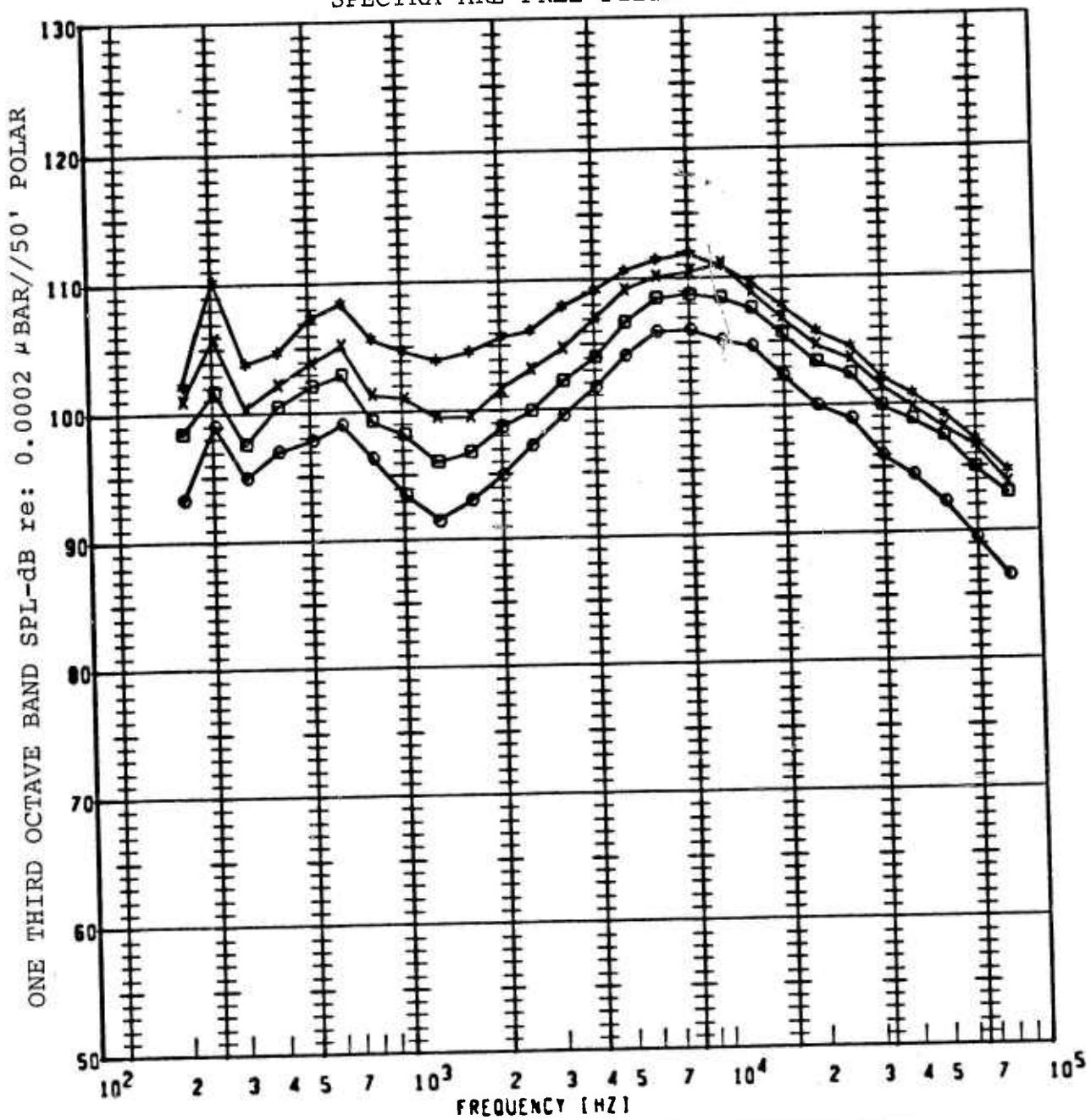


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	193	2.00	1150°F
◊	193	2.50	1150
○	193	3.00	1150
▽	193	4.00	1150

NOZZLE: 37T-6.0AR-CPA-ET/RC

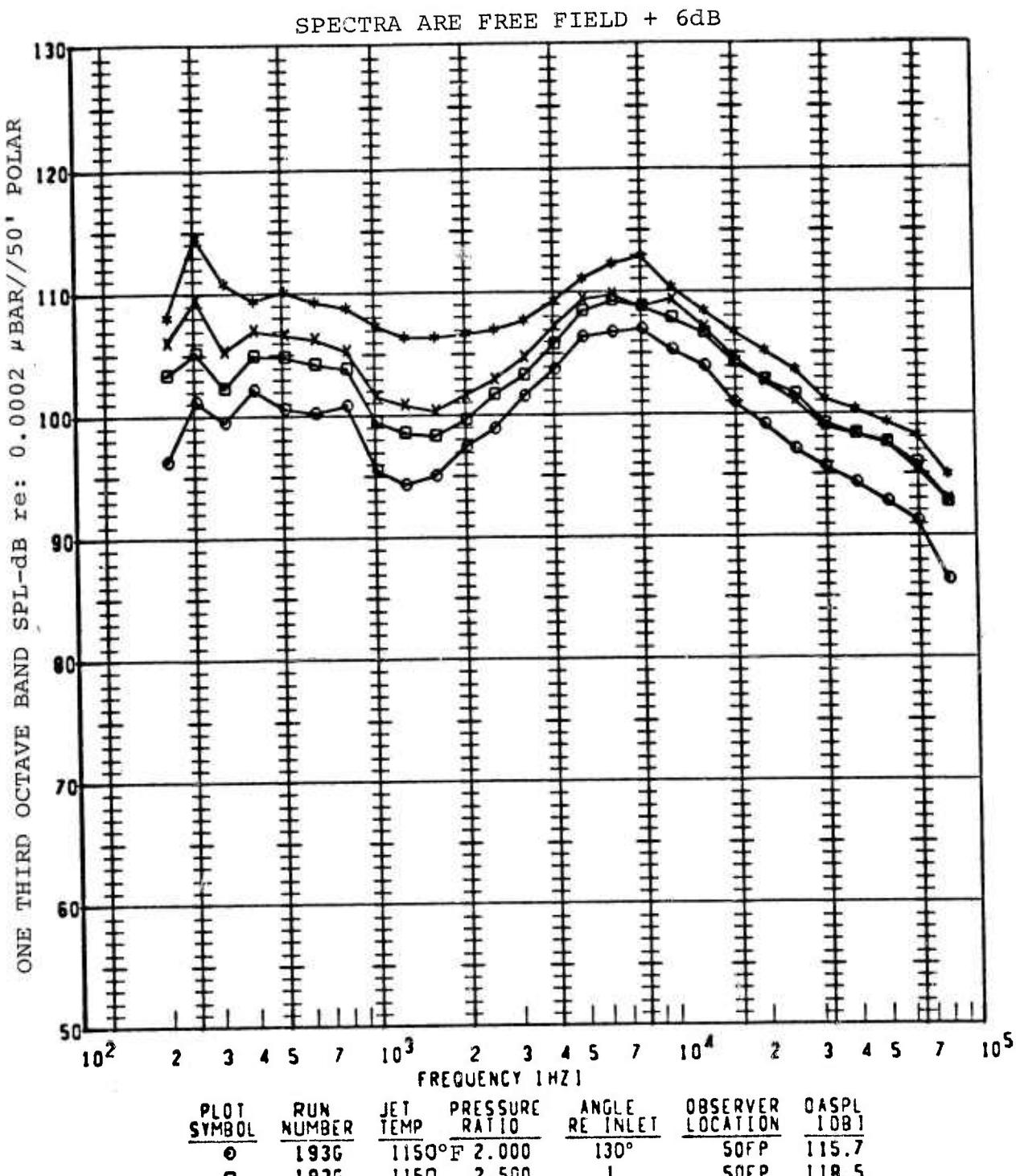
JET NOISE POWER SPECTRA

SPECTRA ARE FREE FIELD + 6dB



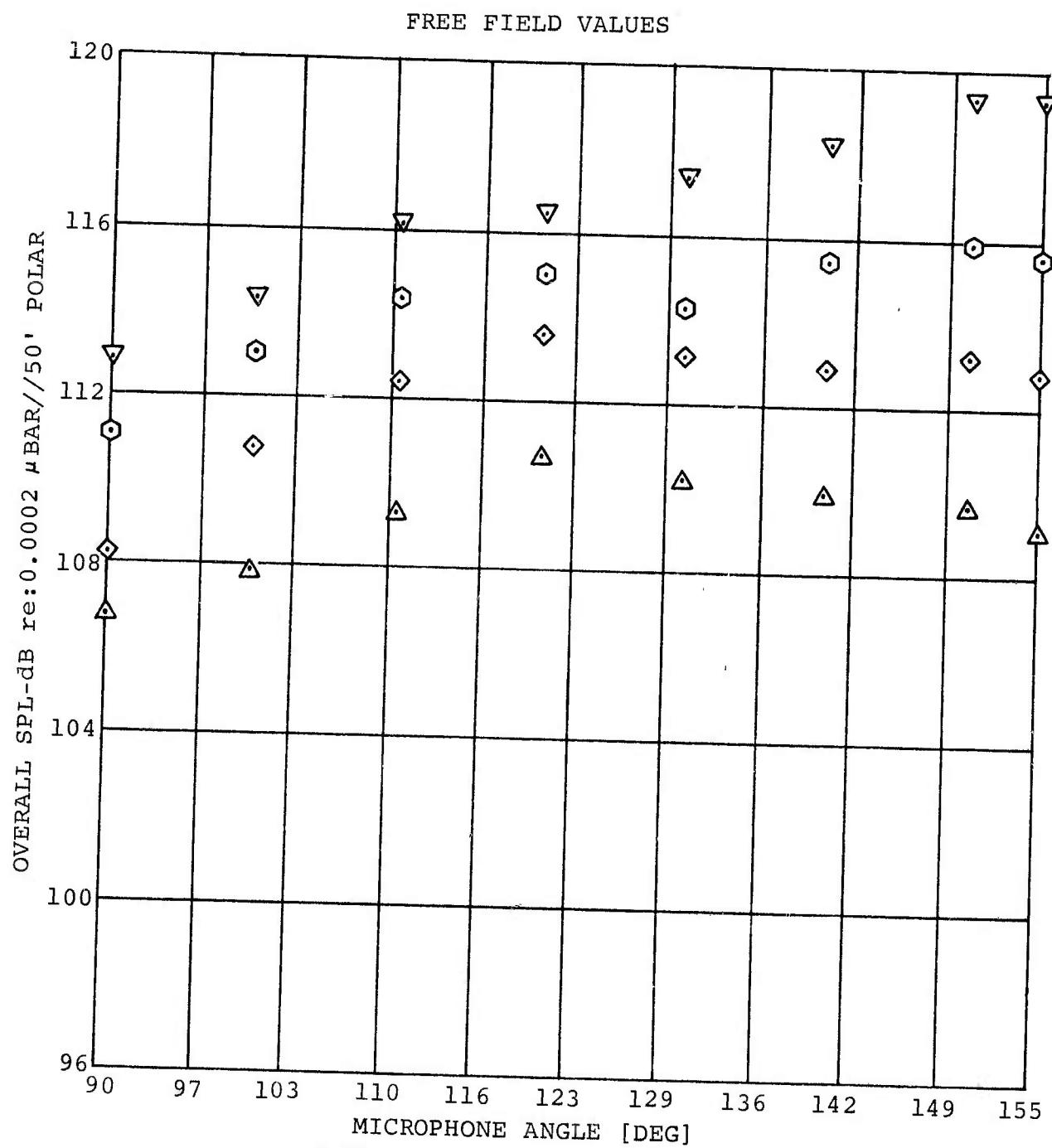
NOZZLE: 37T-6.0AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



NOZZLE: 37T-6.0AR-CPA-ET/RC

MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



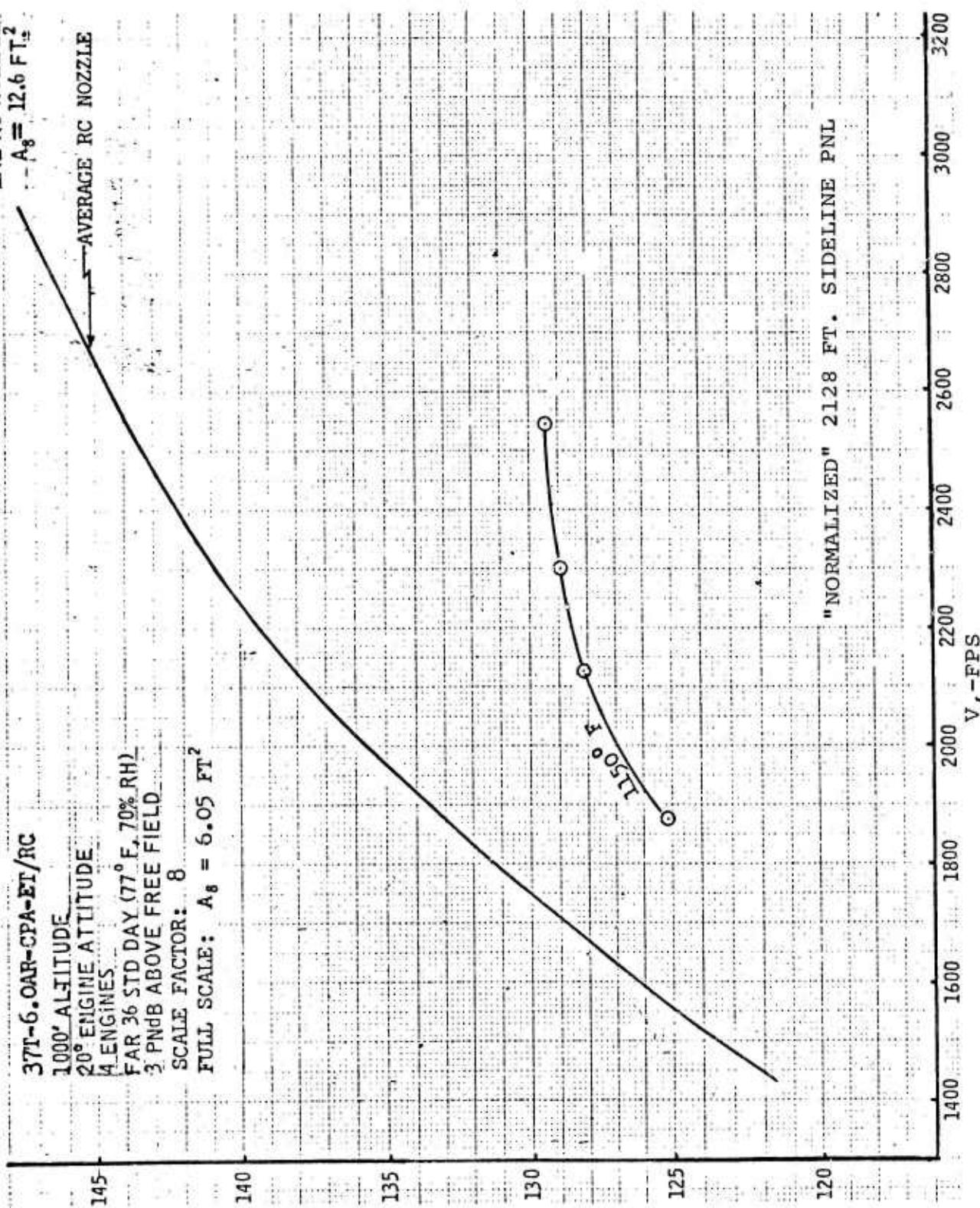
NOZZLE: 37T-6.0AR-CPA-ET/RC

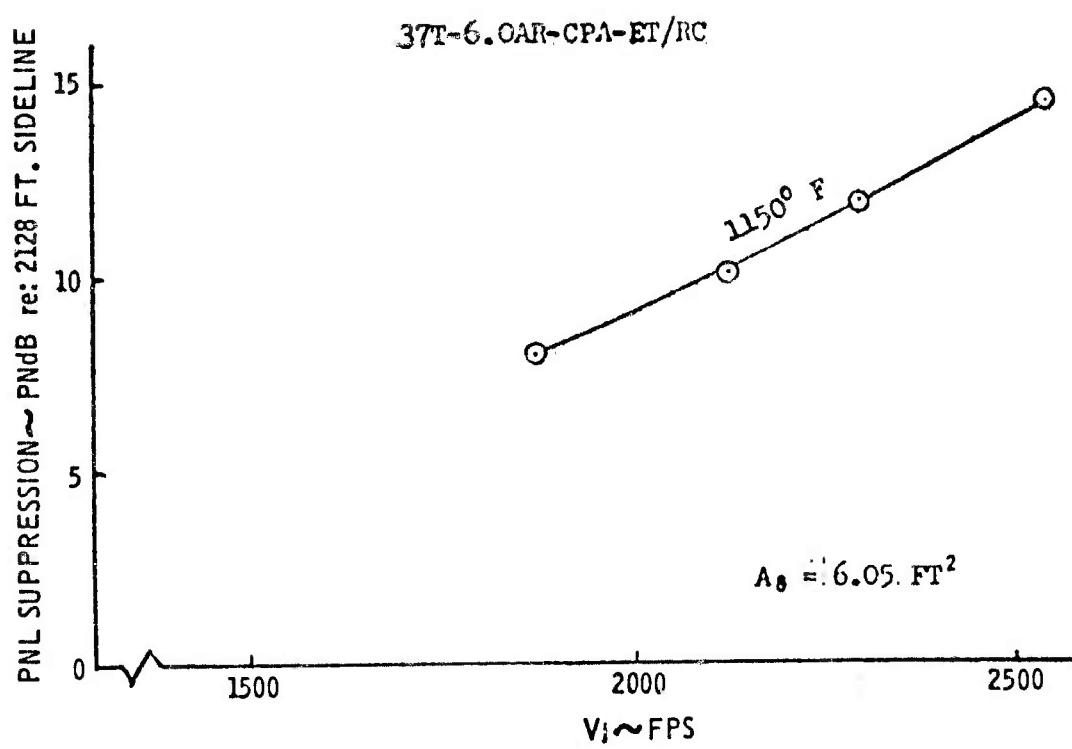
OASPL BEAM PATTERNS

SAE RC NOZZLE
 $A_g = 12.6 \text{ FT}^2$

AVERAGE RC NOZZLE

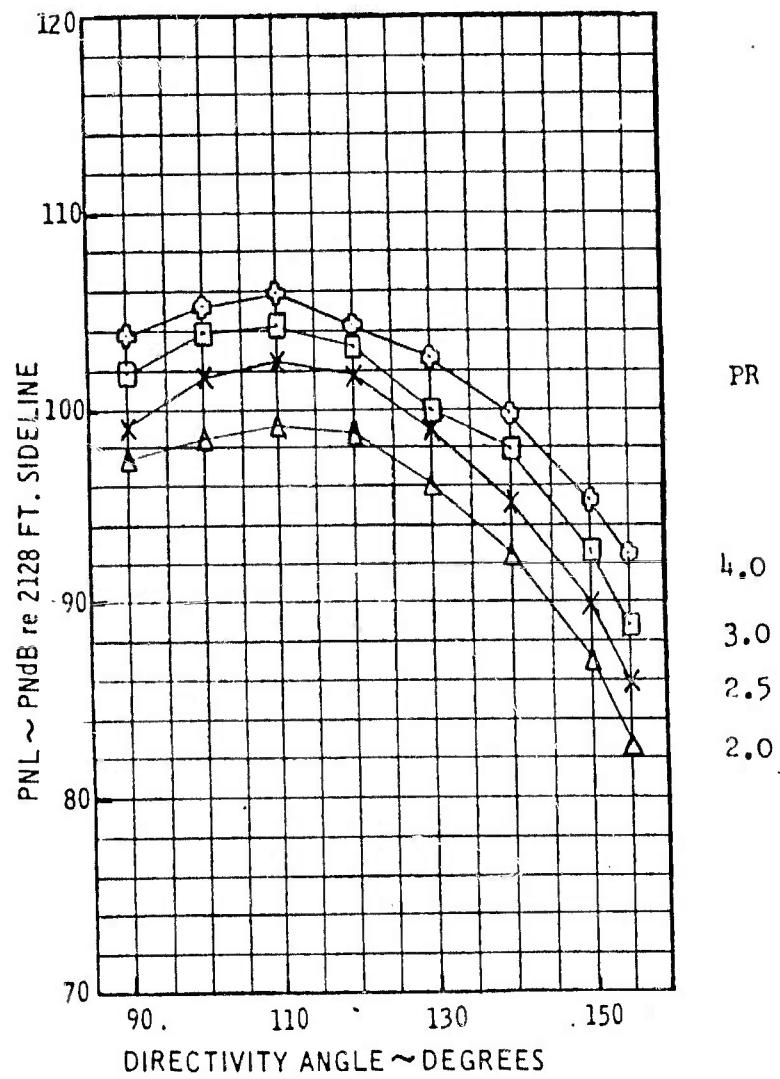
37T-6.OAR-CPA-ET/RC
1000' ALTITUDE
20° ENGINE ATTITUDE
4 ENGINES
FAR 36 STD DAY (77° F, 70% RH)
3 PndB ABOVE FREE FIELD
SCALE FACTOR: 8
FULL SCALE: $A_g = 6.05 \text{ FT}^2$





PEAK PNL SUPPRESSION VALUES

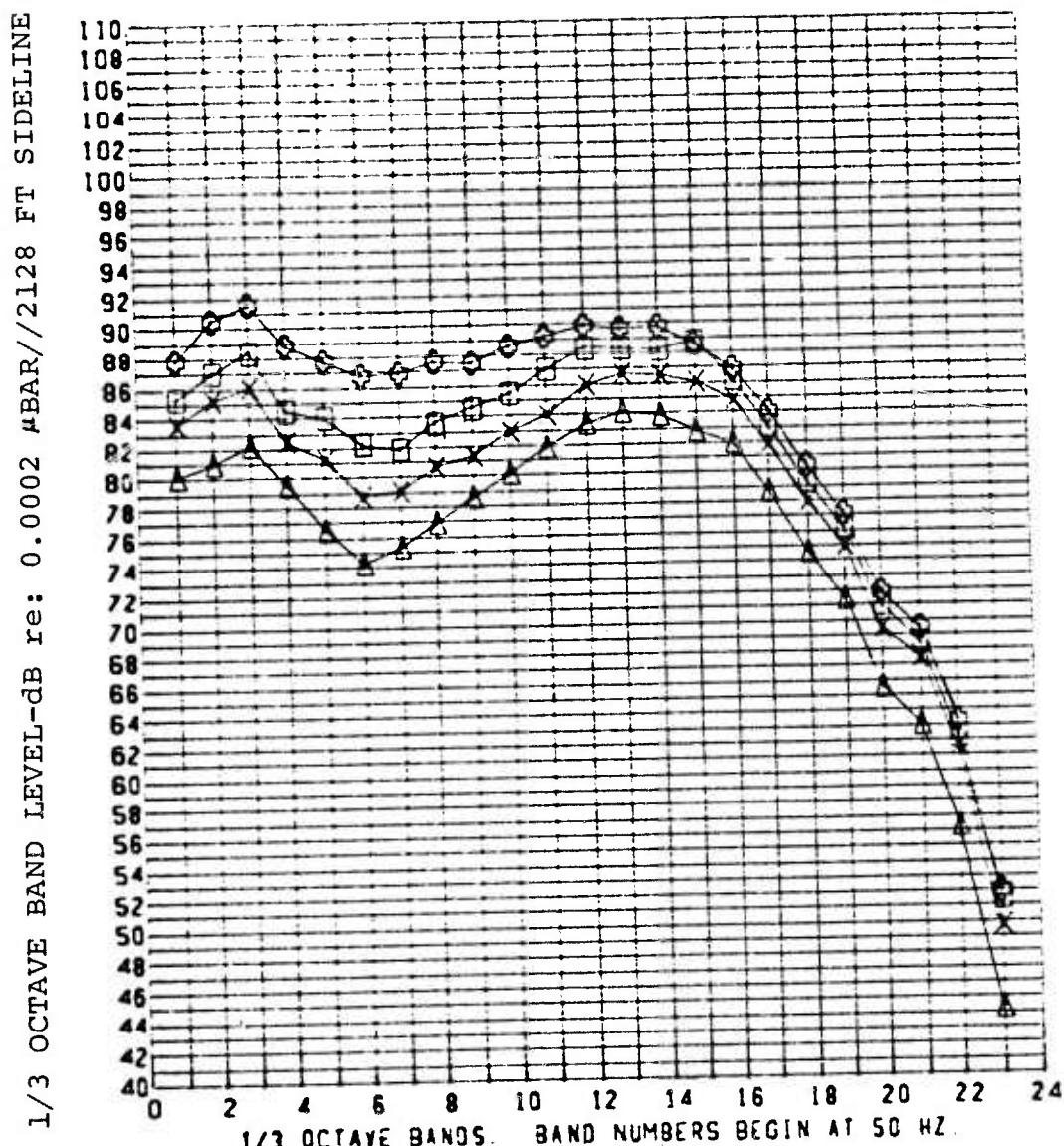
NOZZLE: 37r-6.0AR-CPA-ET/RC



RUN 193
 $T_t = 1150^{\circ} F$ $A_B = 6.05 \text{ FT}^2$

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



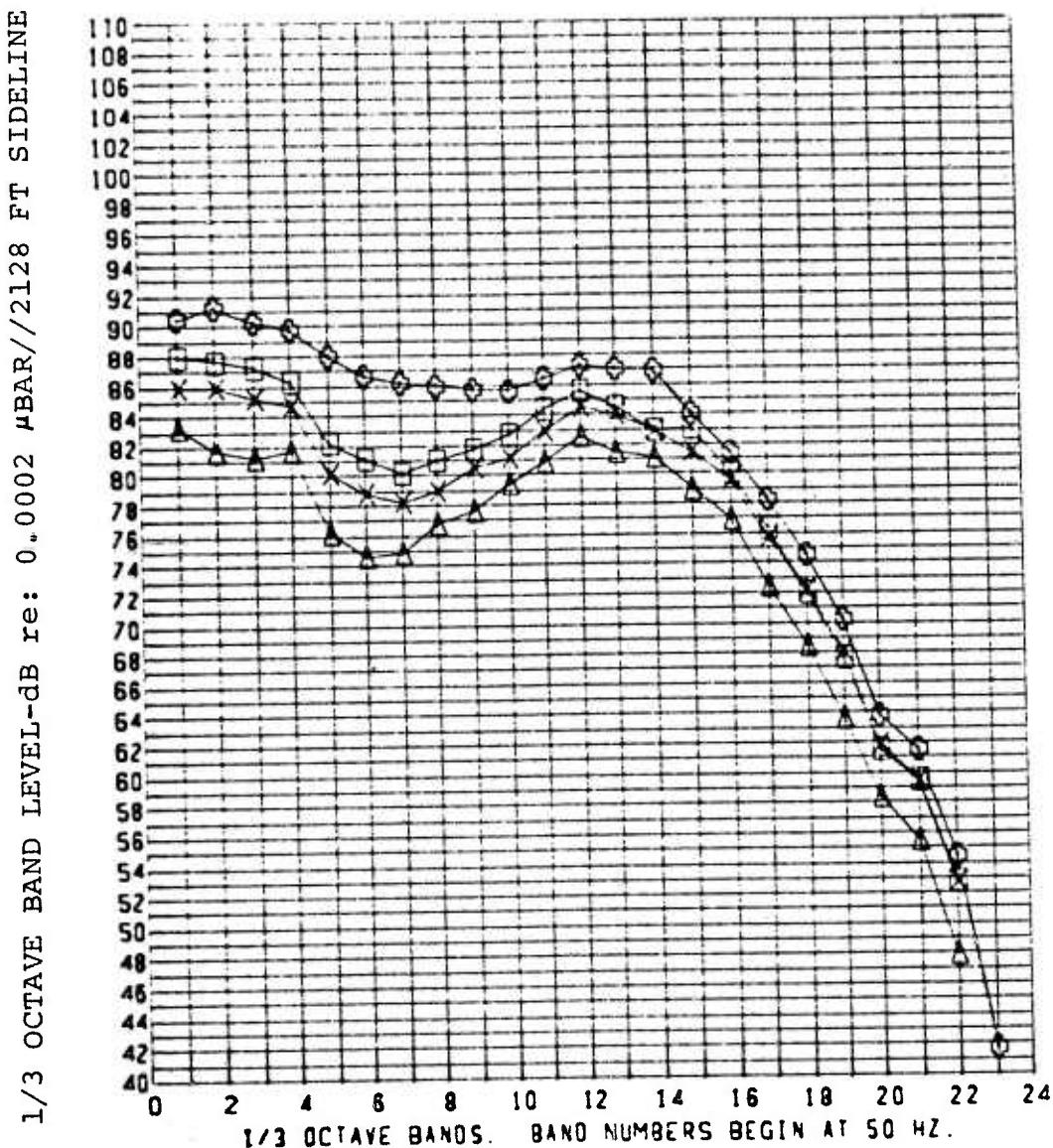
TT = 1150°F A8 = 6.05 FT² RUN: 193
PR = Δ 2.0, \times 2.5, \square 3.0, \pm 4.0

NOZZLE: 37T-6.0AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 193

PR = △ 2.0, × 2.5, □ 3.0, + 3.4, ◇ 4.0

NOZZLE: 37T-6.0AR-CPA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°

re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 37T-6.0AR-CPA-ET/RC

FACILITY: WALL ISOLATION FACILITY

DATE: January 15, 1973

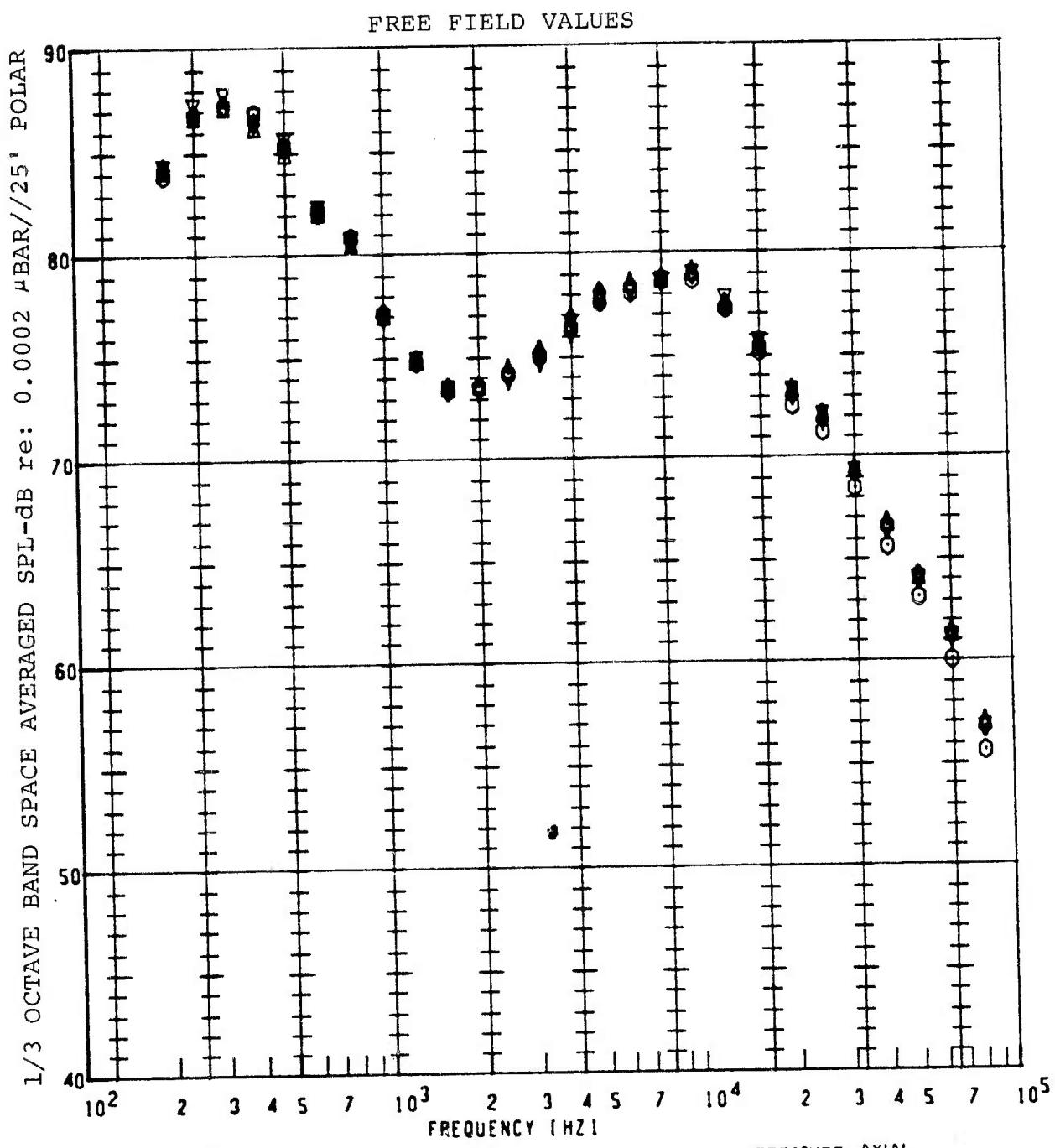
P_{AMB} = 29.58 in Hg **T_{AMB}** = 46°F **R.H.** = 78%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

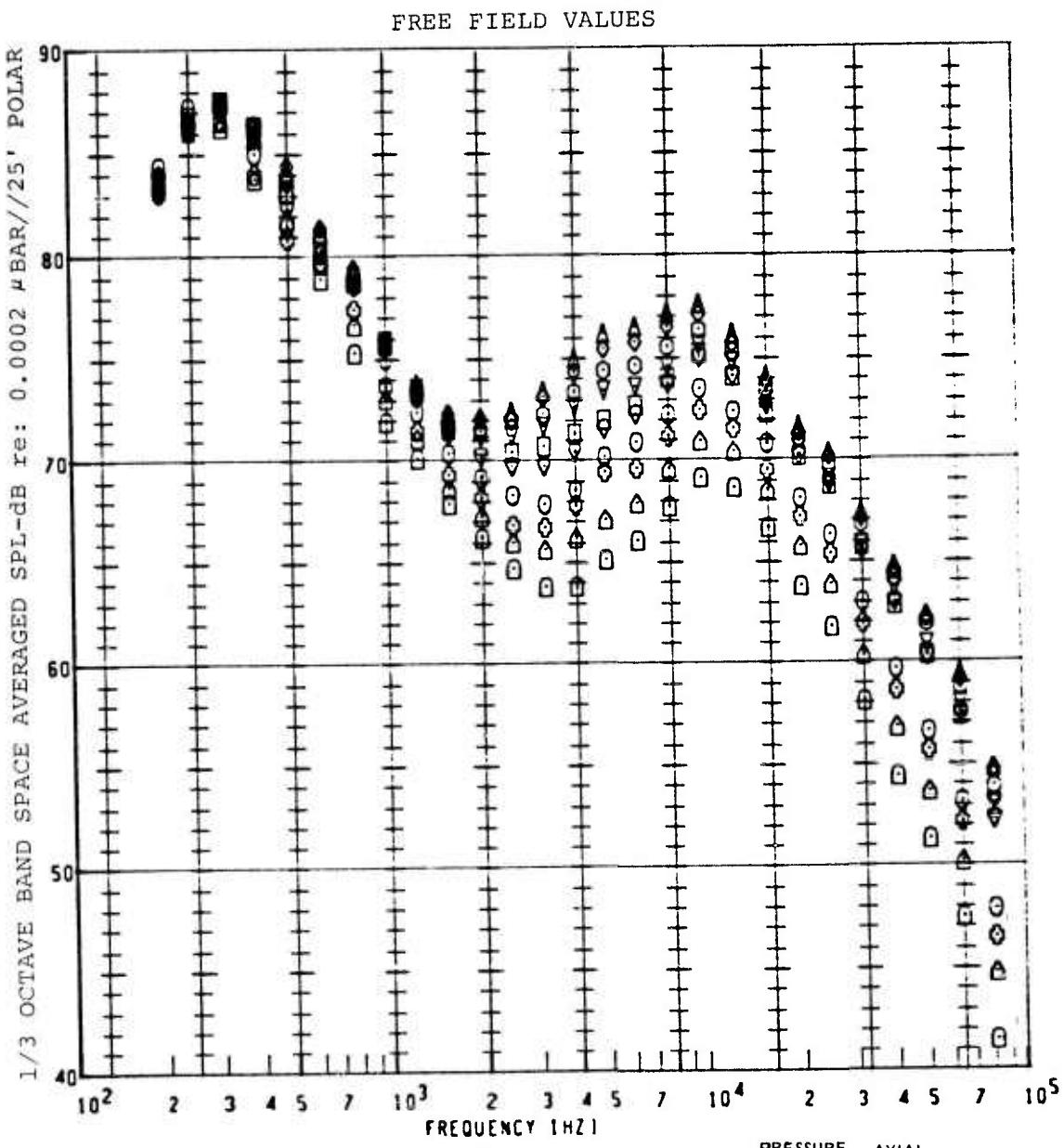
SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>AXIAL LOCATION</u>	<u>IRIS DIA.</u>	<u>REMARKS</u>	<u>REF.</u>
2	0.0 x/D	12.5 in.		
3	.25	12.5		
4	.50	13.0		
5	.75	13.0		
6	1.00	13.5		
7	1.25	13.5		
8	1.50	14.0		
9	1.75	14.0		
10	2.00	14.5		
11	2.25	14.5		
12	2.50	15.0		
13	2.75	15.0		
14	3.0	15.5		
15	3.5	15.5		
16	4.0	16.0		
17	5.0	19.0		
18	6.0	20.0		
19	8.0	22.0		
20	10.0	24.0		
21	12.0	27.5		

MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

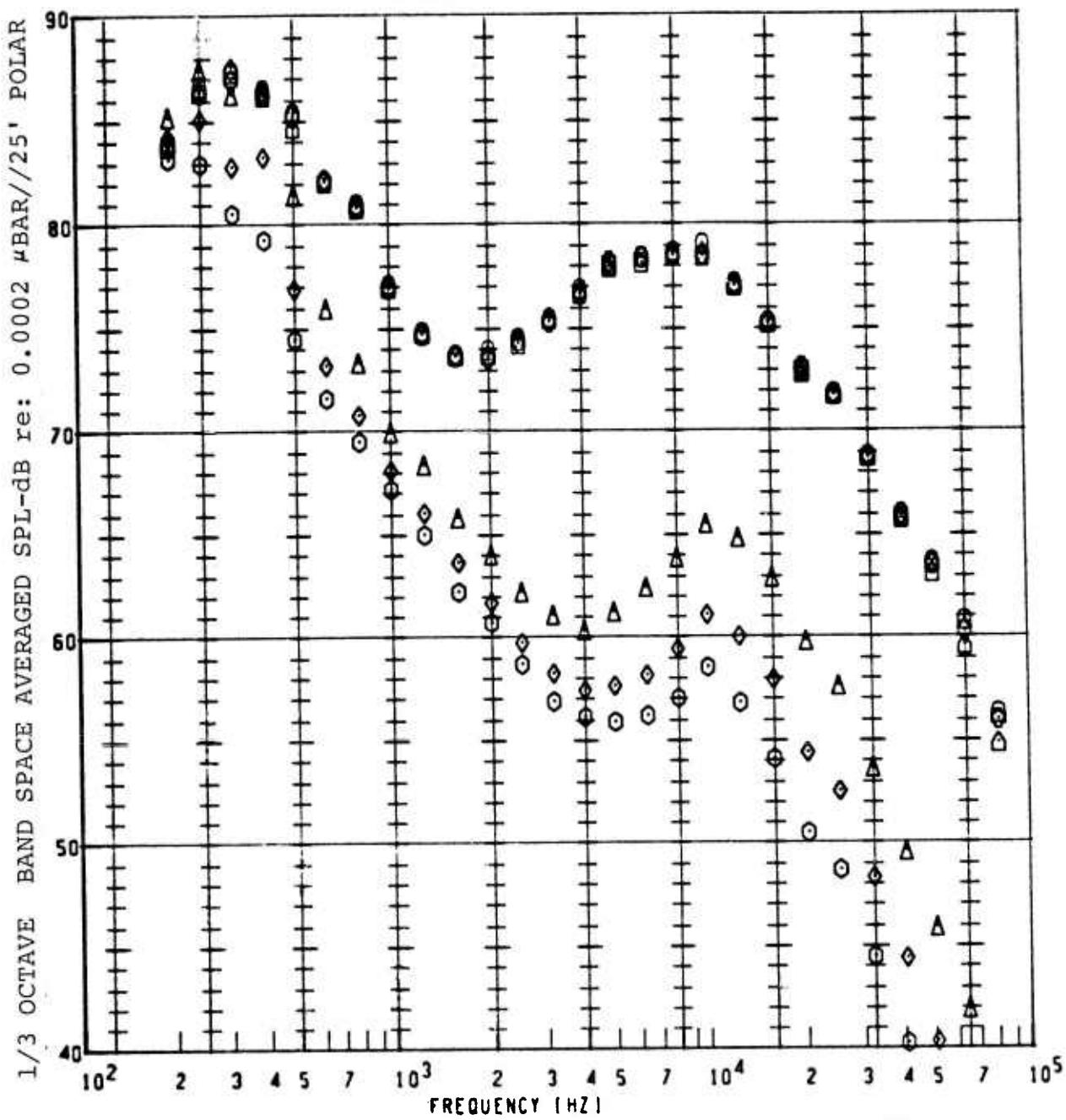


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	5	1150°F	3.0	.75
◊	6	1150	3.0	1.0
▽	7	1150	3.0	1.25
○	8	1150	3.0	1.5

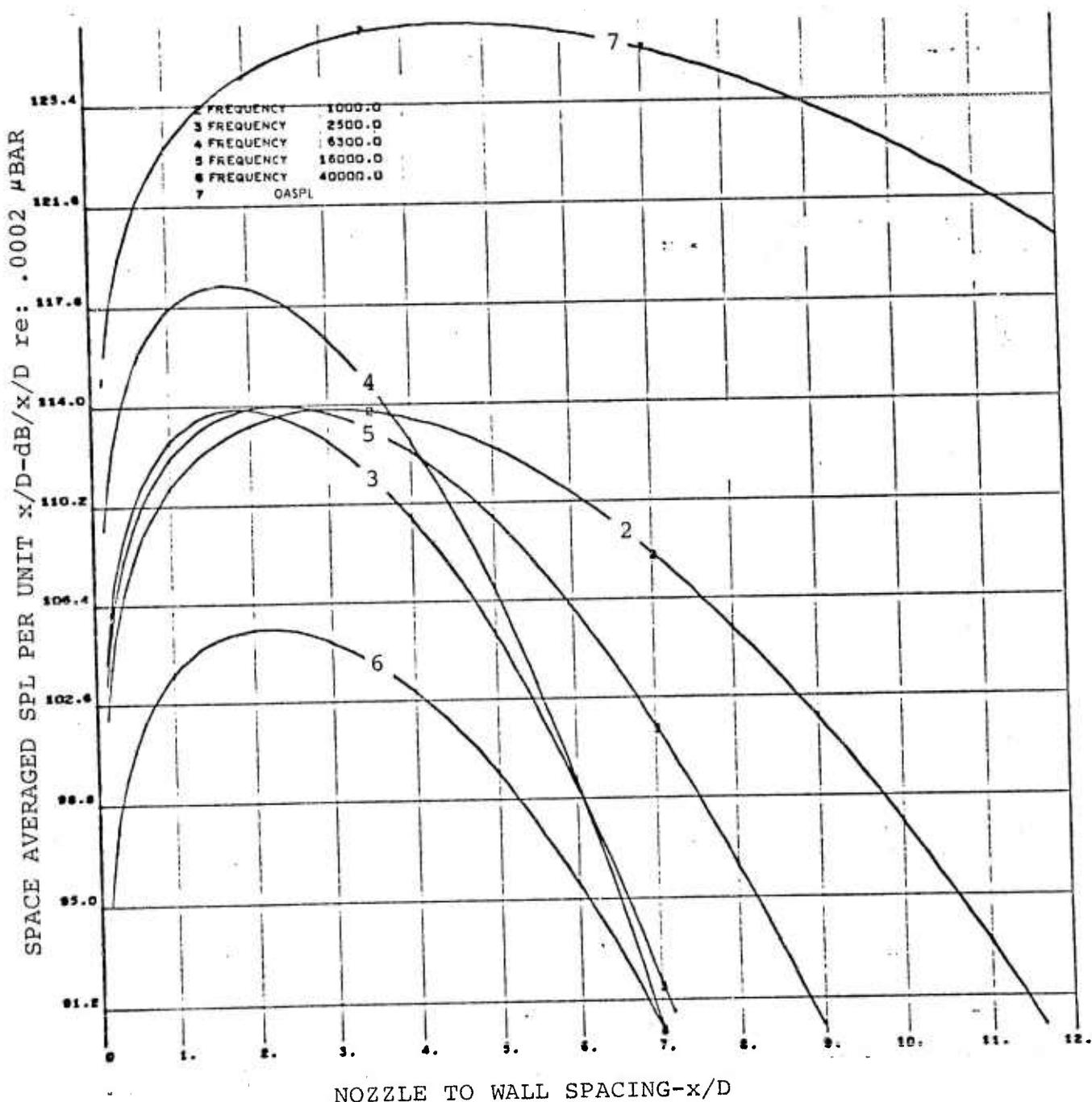


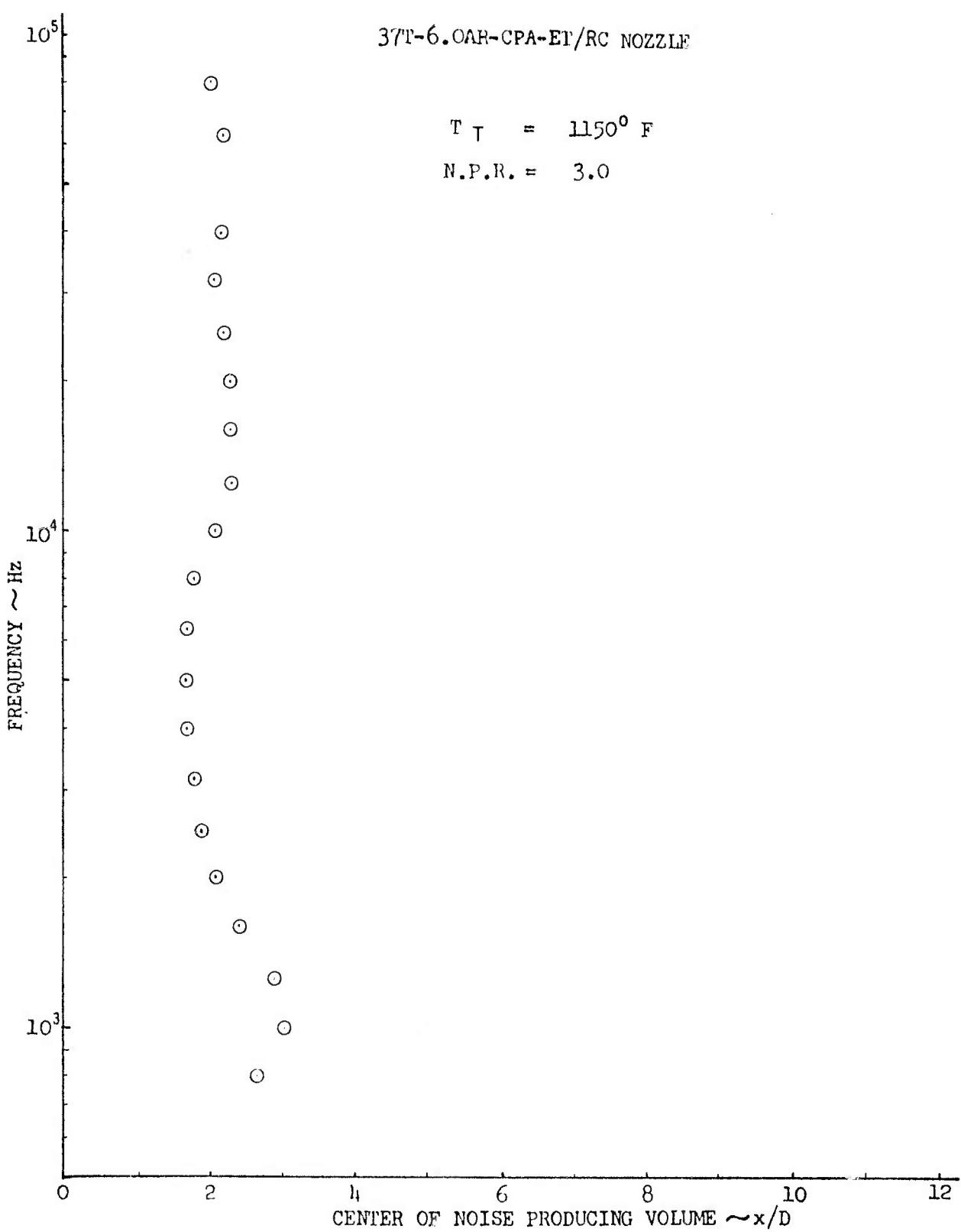
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	9	1150°F	3.0	1.75
□	10	1150	3.0	2.0
○	11	1150	3.0	2.25
▽	12	1150	3.0	2.50
◆	13	1150	3.0	2.75
◆	14	1150	3.0	3.0
○	15	1150	3.0	3.50
▽	16	1150	3.0	4.0
△	17	1150	3.0	5.0
□	18	1150	3.0	6.0

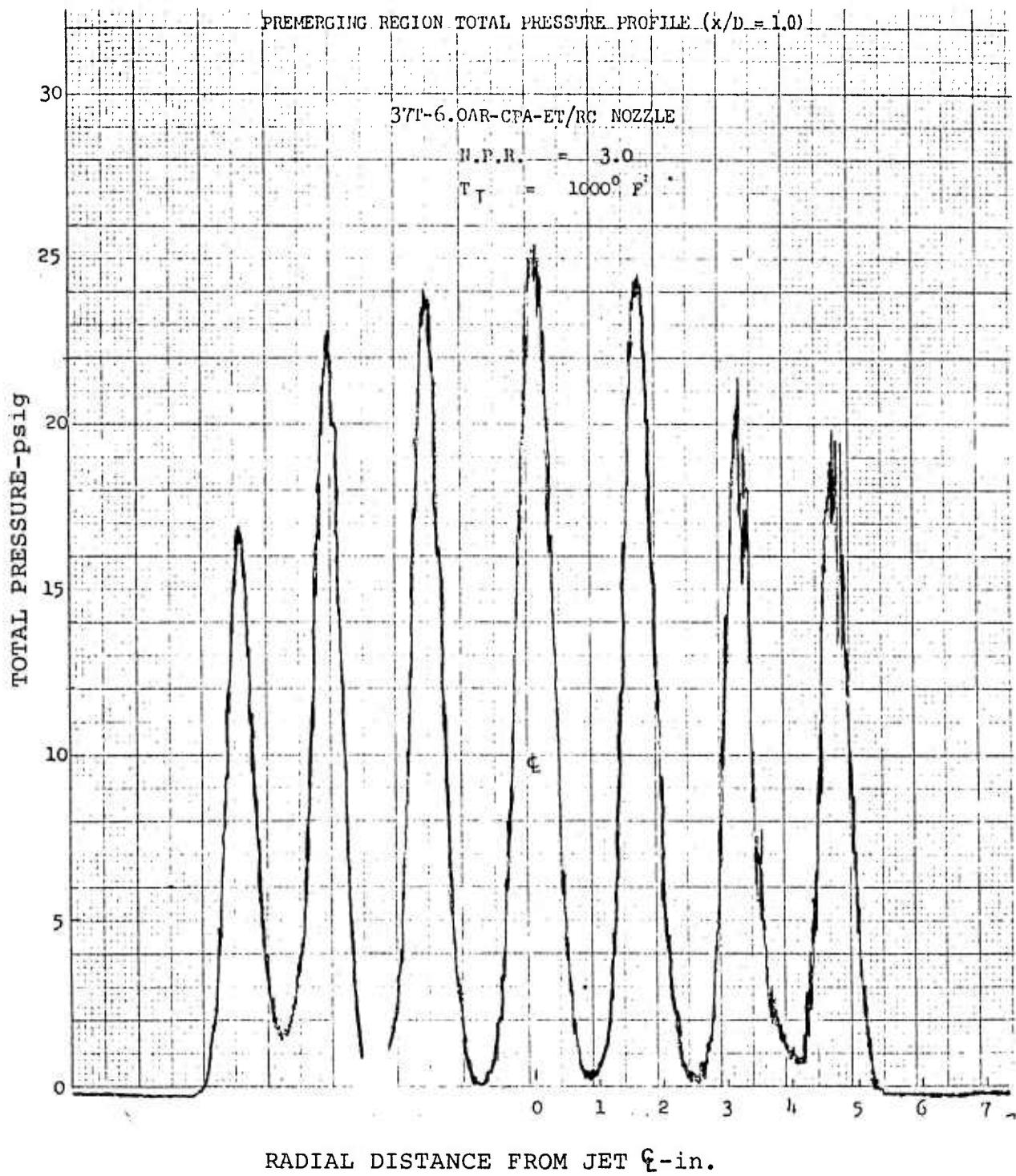
FREE FIELD VALUES

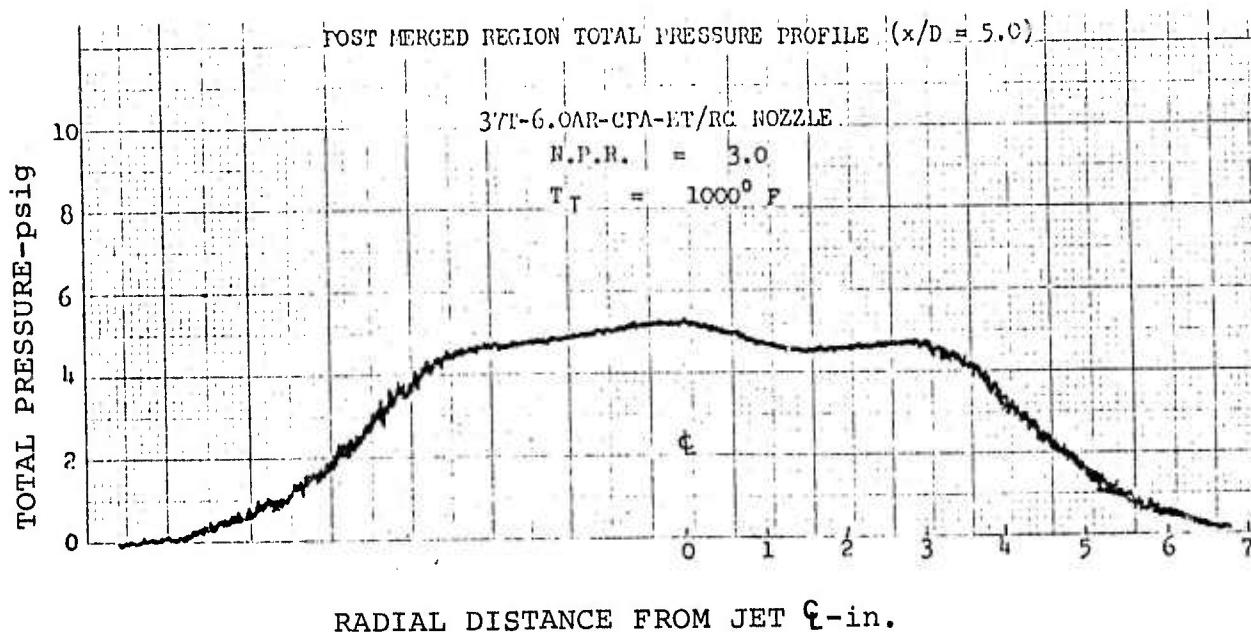


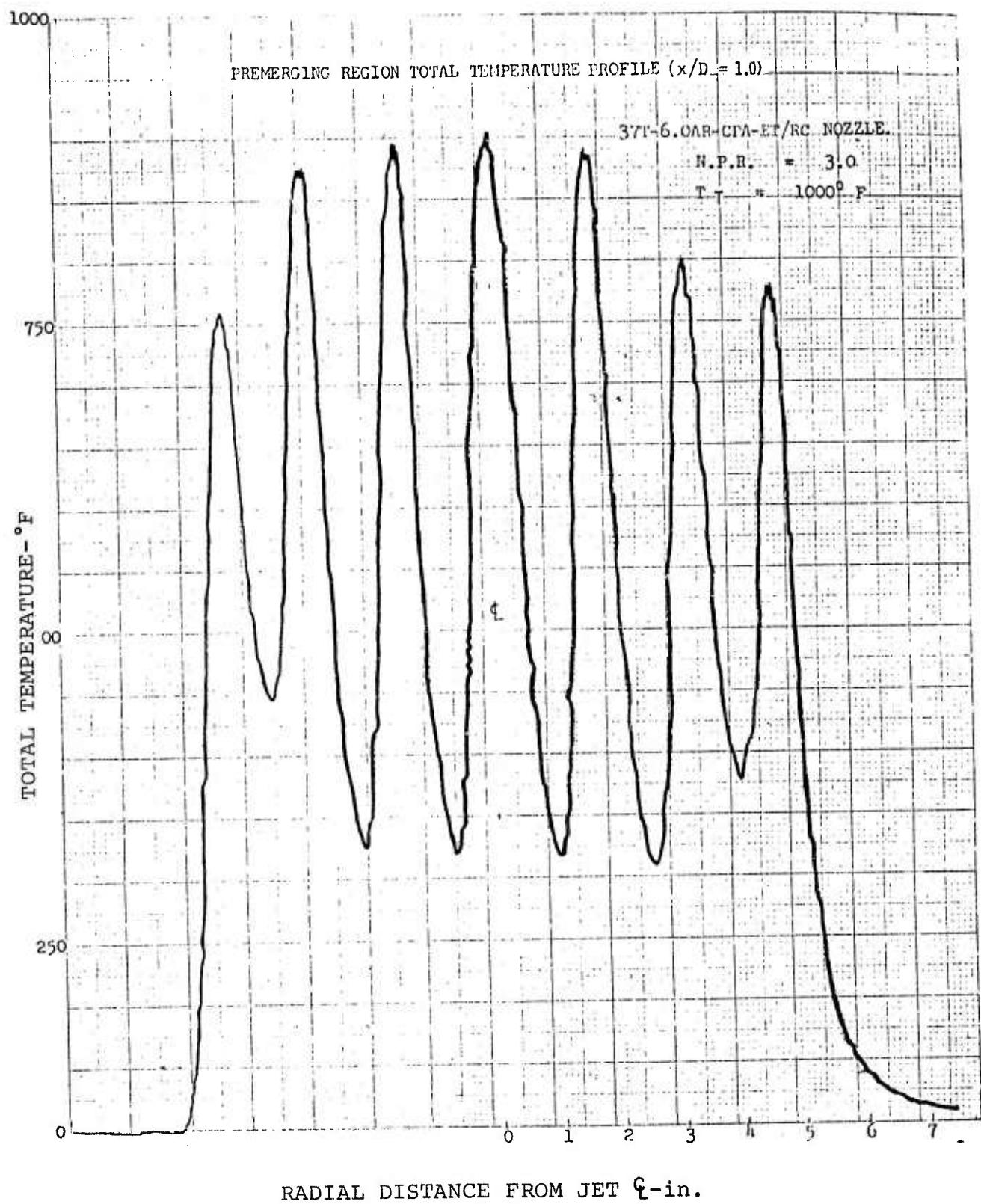
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE AXIAL RATIO	LOCATION, x/D
Δ	19	1150°F	3.0	8.0
○	20	1150	3.0	0.0
○○○	21	1150	3.0	2.0
□□□	2	1150	3.0	0
□□	3	1150	3.0	.25
□□	4	1150	3.0	.5

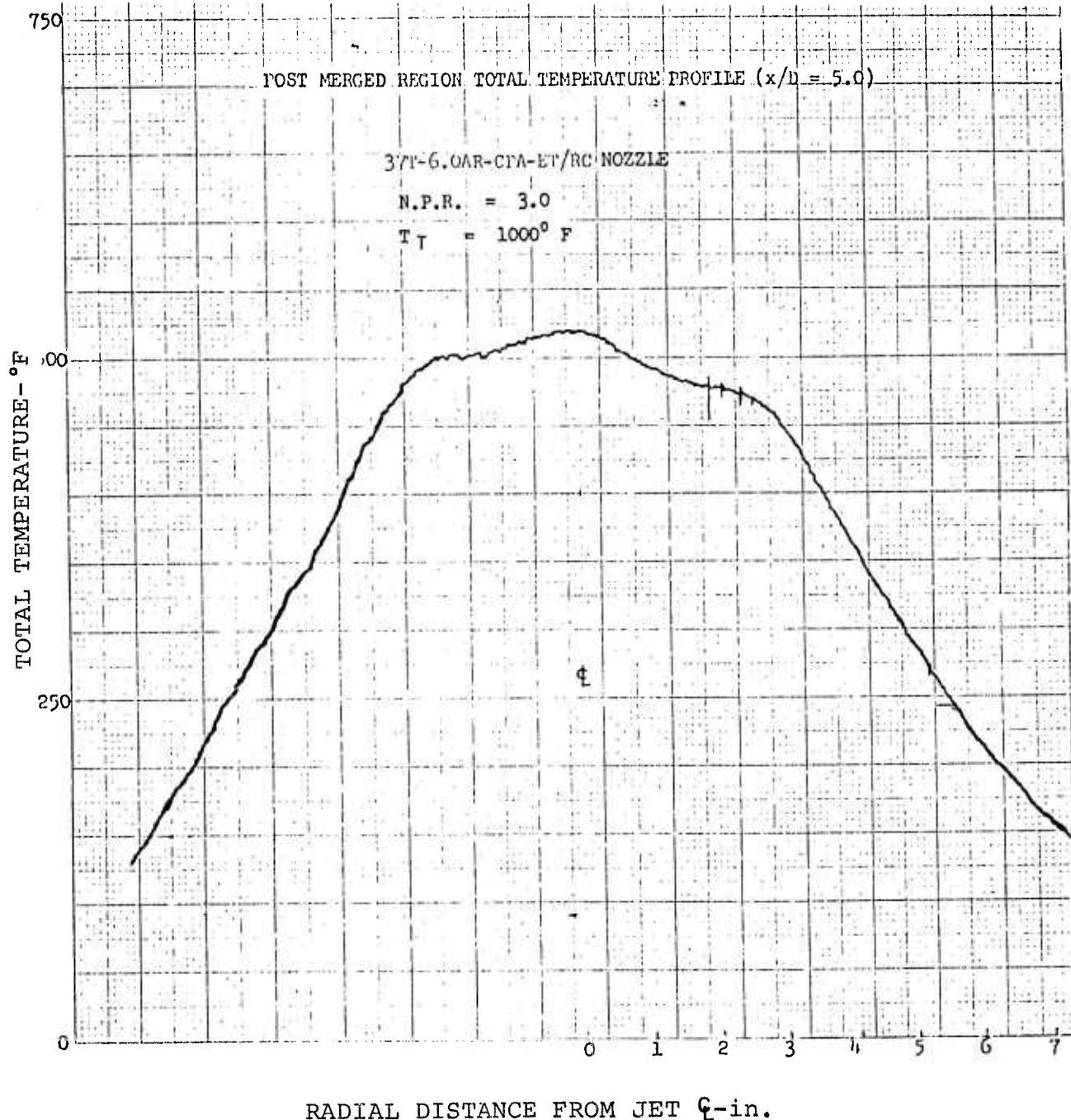


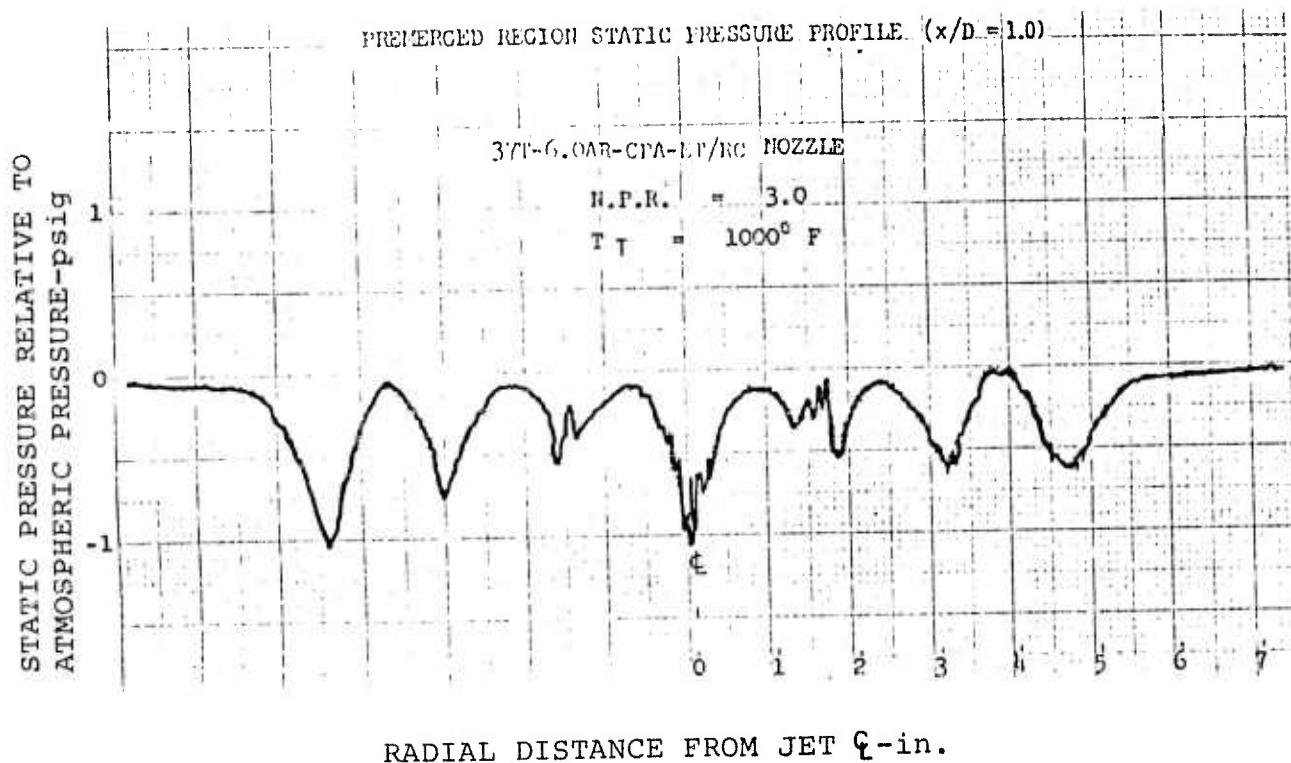




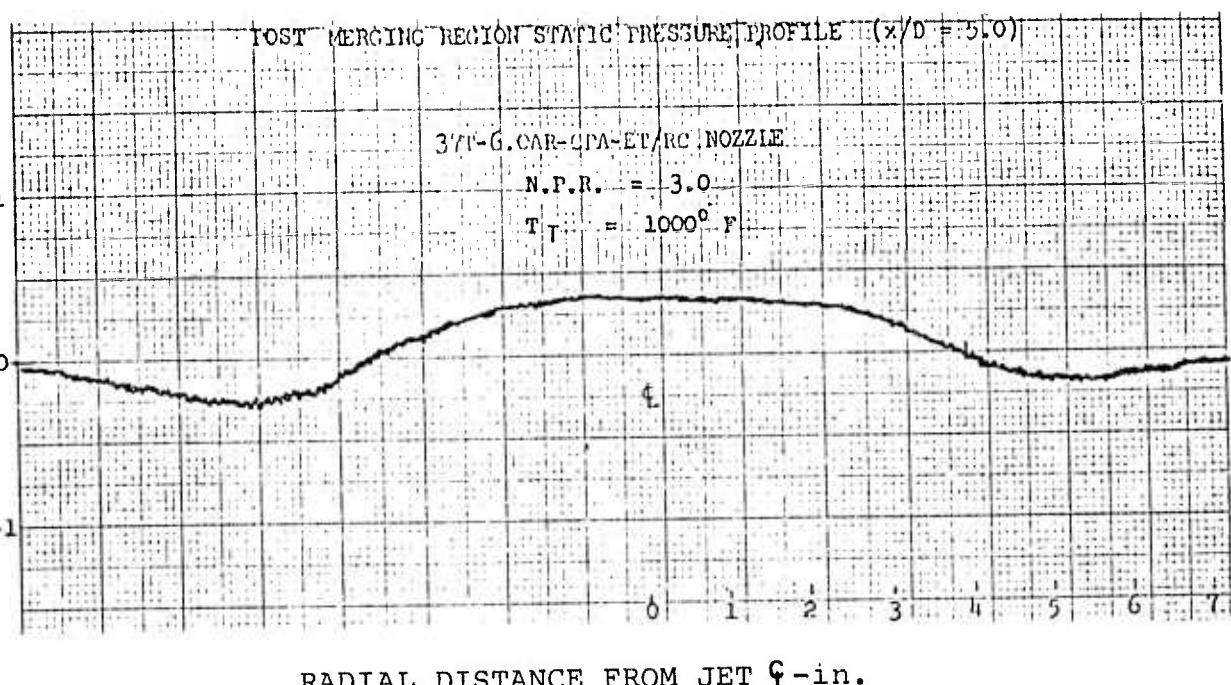


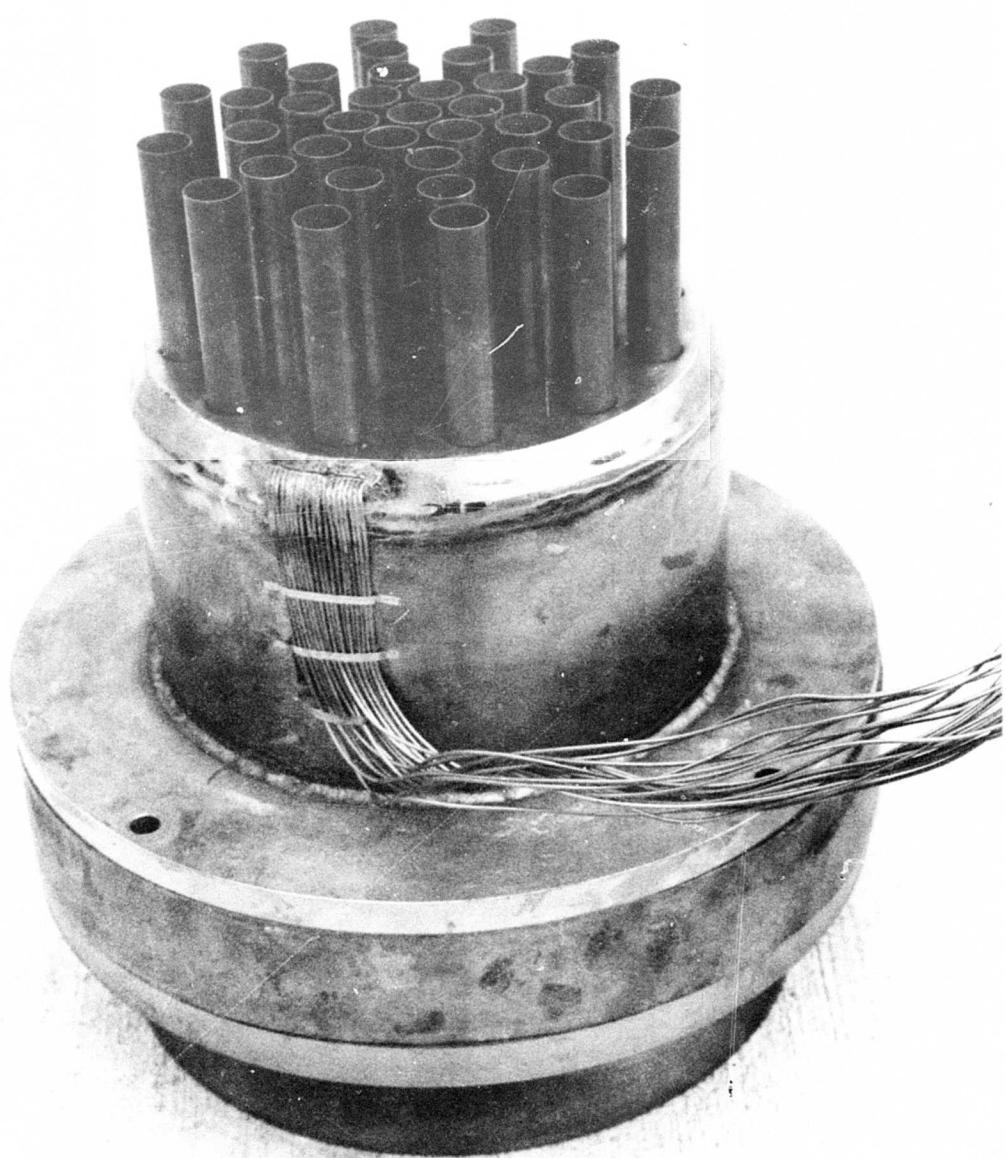




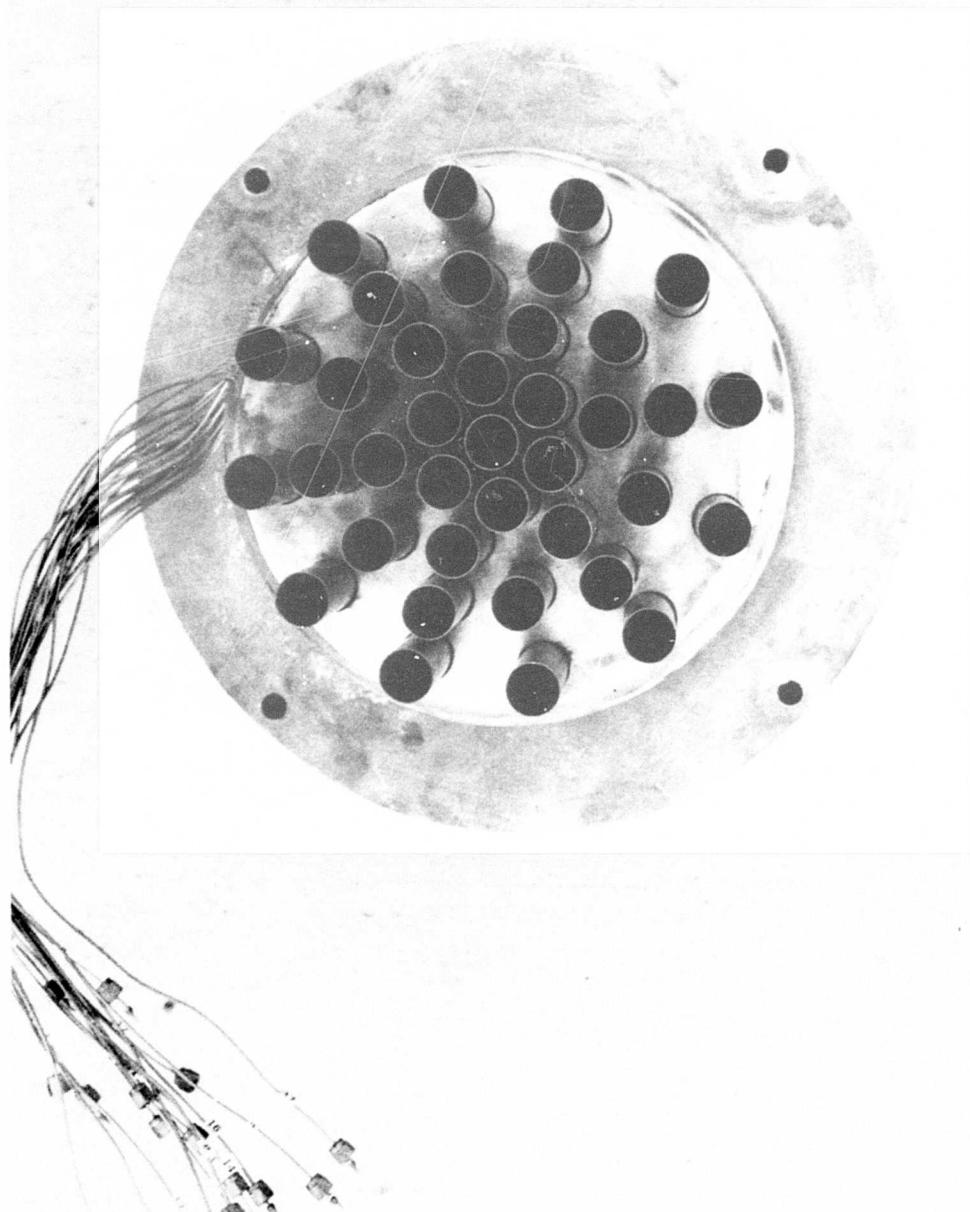


STATIC PRESSURE RELATIVE TO
ATMOSPHERIC PRESSURE-psig





37T-3.3AR-RA-RT/NC NOZZLE

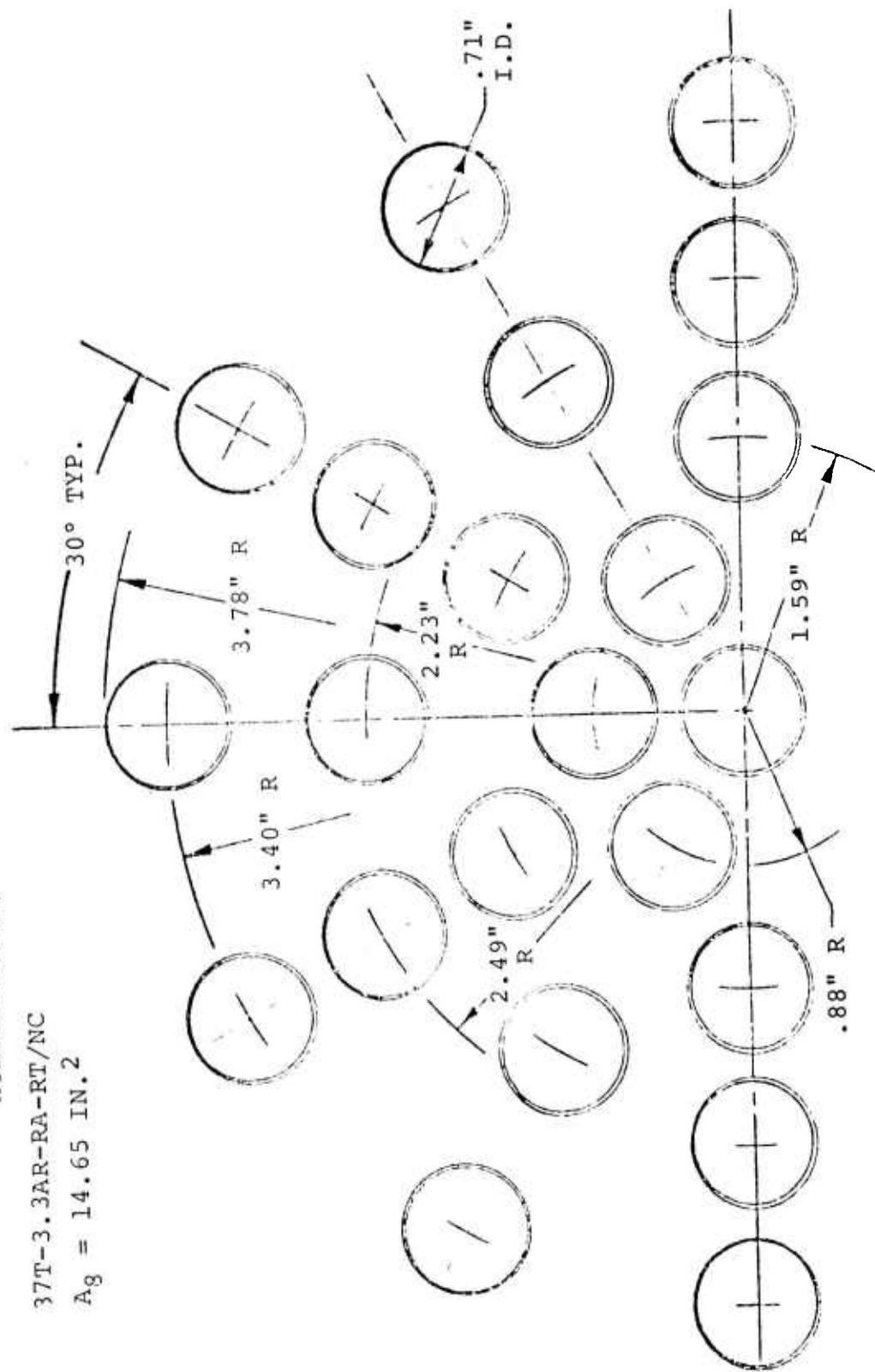


37T-3.3AR-RA-RT/NC NOZZLE

MAR'L - .75" DIA. .020 WALL

TUBE LENGTH = 6.0" (EXIT PLANE TO TUBE
HOLDER PLATE)

37T-3.3AR-RA-RT/NC
 $A_g = 14.65 \text{ IN.}^2$



TEST CONDITIONS

NOZZLE: 37T-3.3AR-RA-ET/NC

FACILITY: HNTF

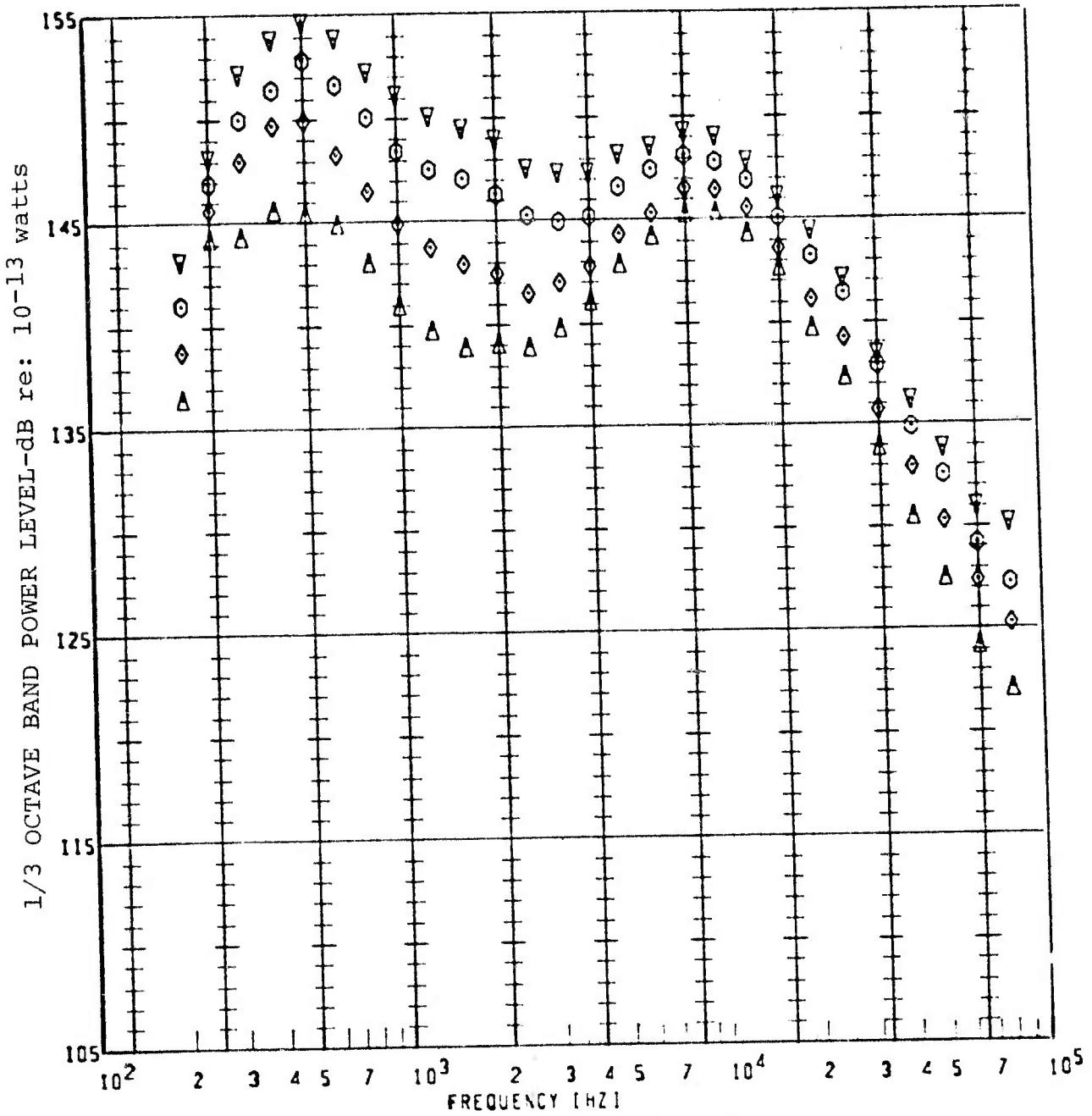
DATE: 6-11-73 **T_{AMB}** = 68°F **R.H.** = 58%

SCALE MODEL A₈ = 14.65 in.²

RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
10	2.0	1150°F	1875 fps	6" tube lengths	
"	2.5	"	2126	" "	
"	3.0	"	2303	" "	
"	3.5	"	2437	" "	
"	4.0	"	2544	" "	

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

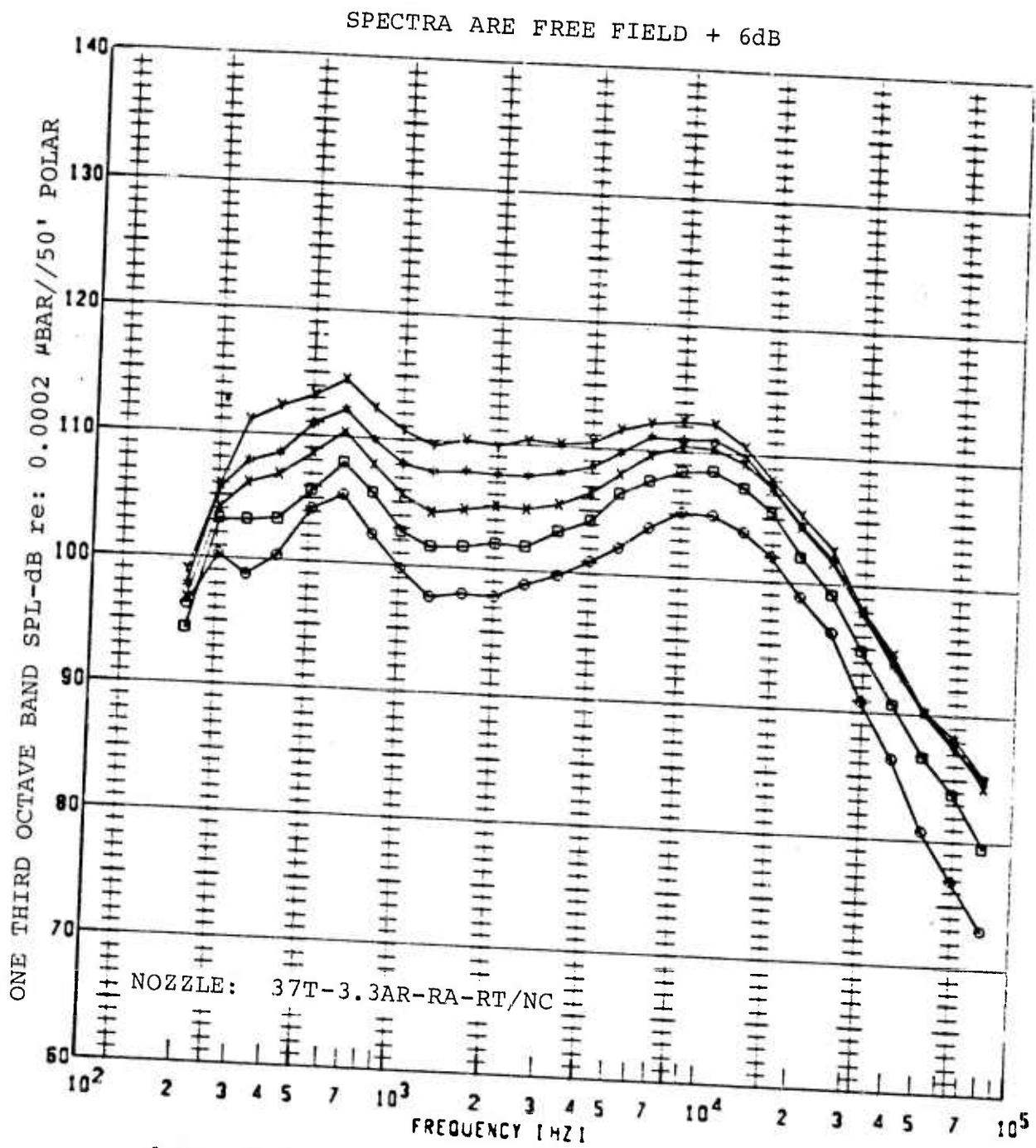
FREE FIELD VALUES



PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
▲	010	2.50	1150°F
◊	010	3.00	1150
○	010	3.50	1150
▽	010	4.00	1150

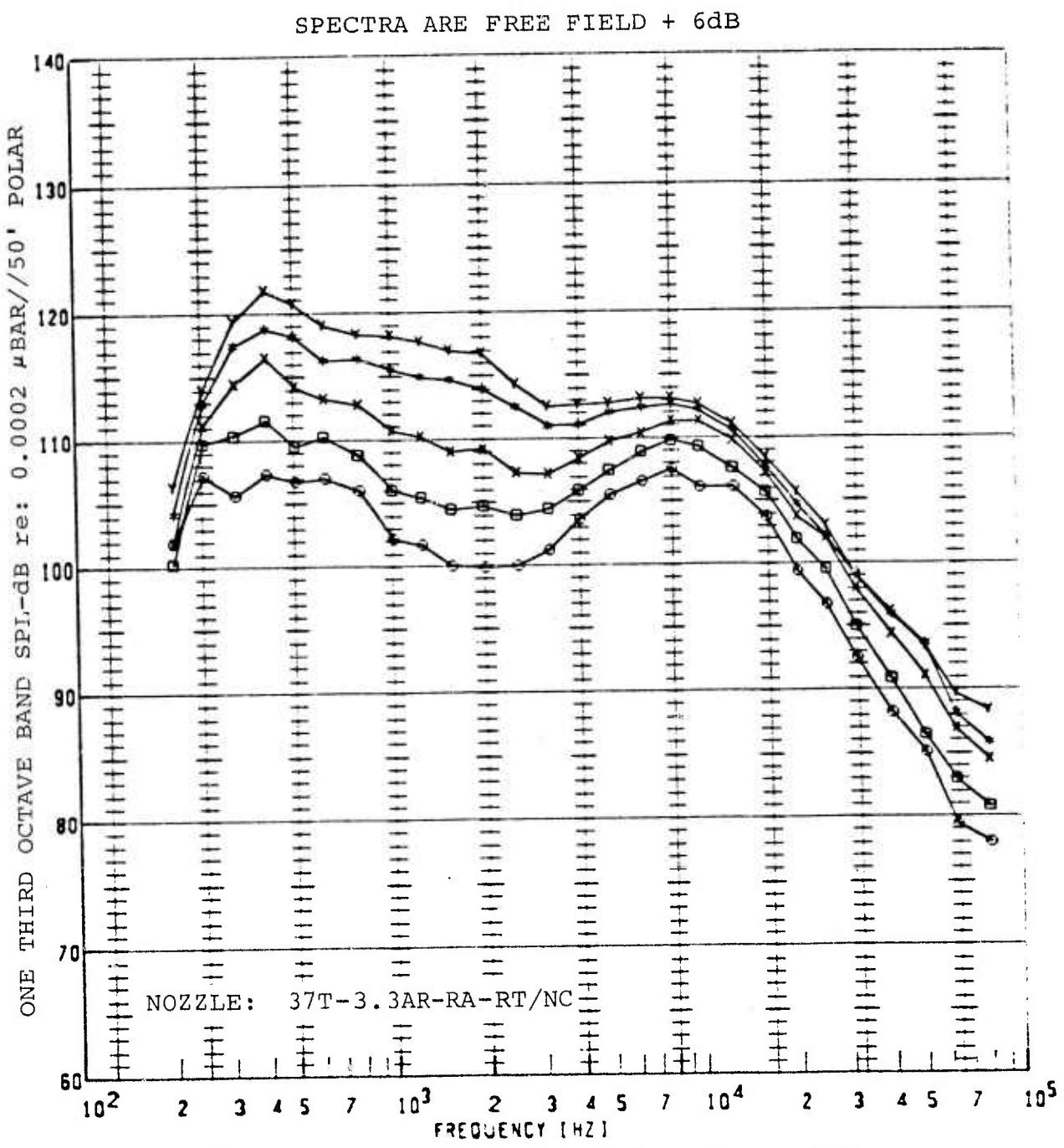
NOZZLE: 37T-3.3AR-RA-RT/NC

JET NOISE POWER SPECTRA



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASL
○	010G	1150°F	2.000	110°	SOFP	113.1
■	010G	1150	2.500		SOFP	115.2
×	010G	1150	3.000		SOFP	118.4
*	010G	1150	3.500		SOFP	120.7
Y	010G	1150	4.000		SOFP	122.2
						124.2

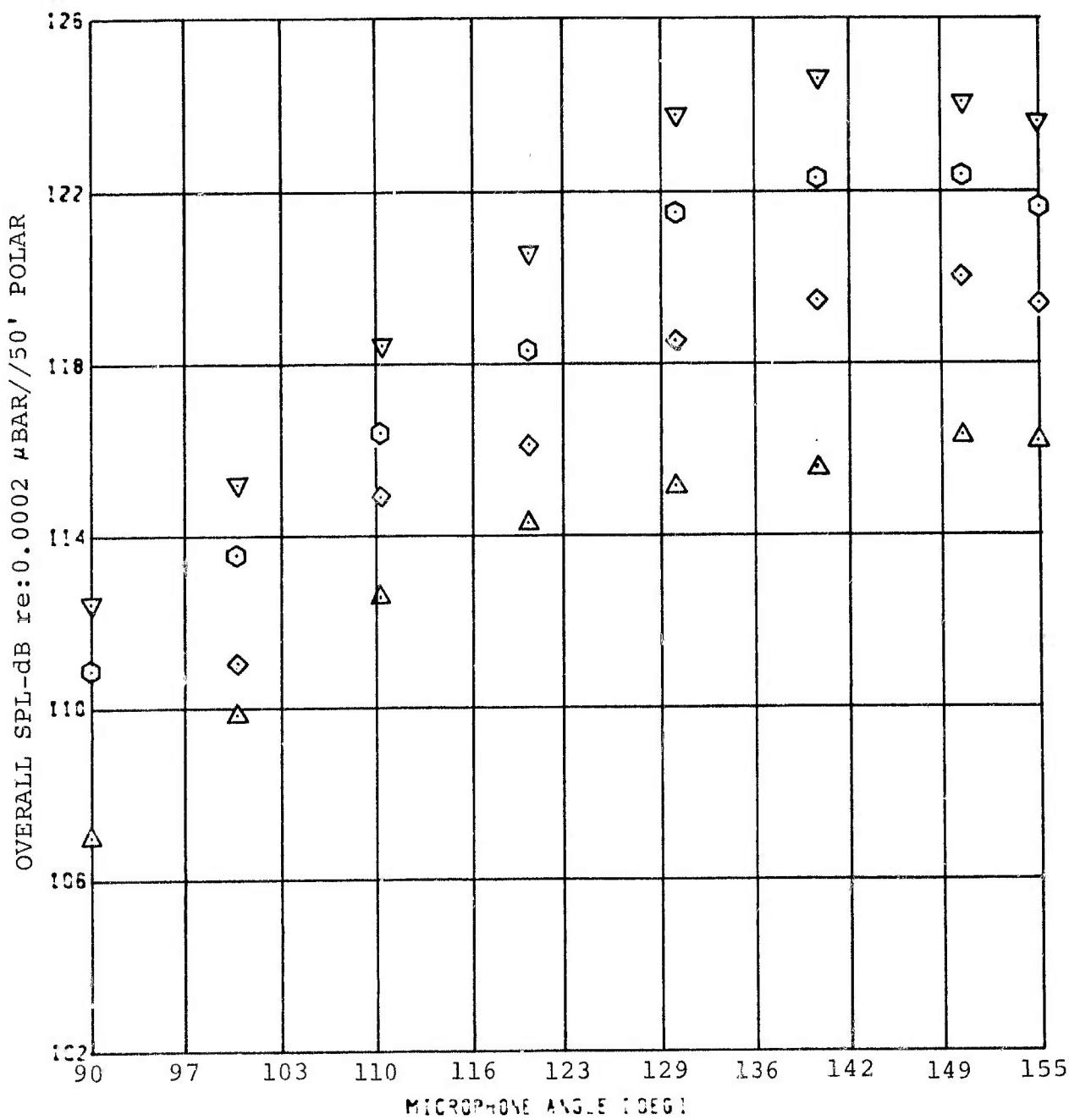
MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	GASPL [dB]
○	010G	1150°F	2.000	130°	SOFP	118.1
■	010G	1150	2.500		SOFP	121.1
×	010G	1150	3.000		SOFP	124.4
*	010G	1150	3.500		SOFP	127.5
△	010G	1150	4.000		SOFP	129.6

MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS

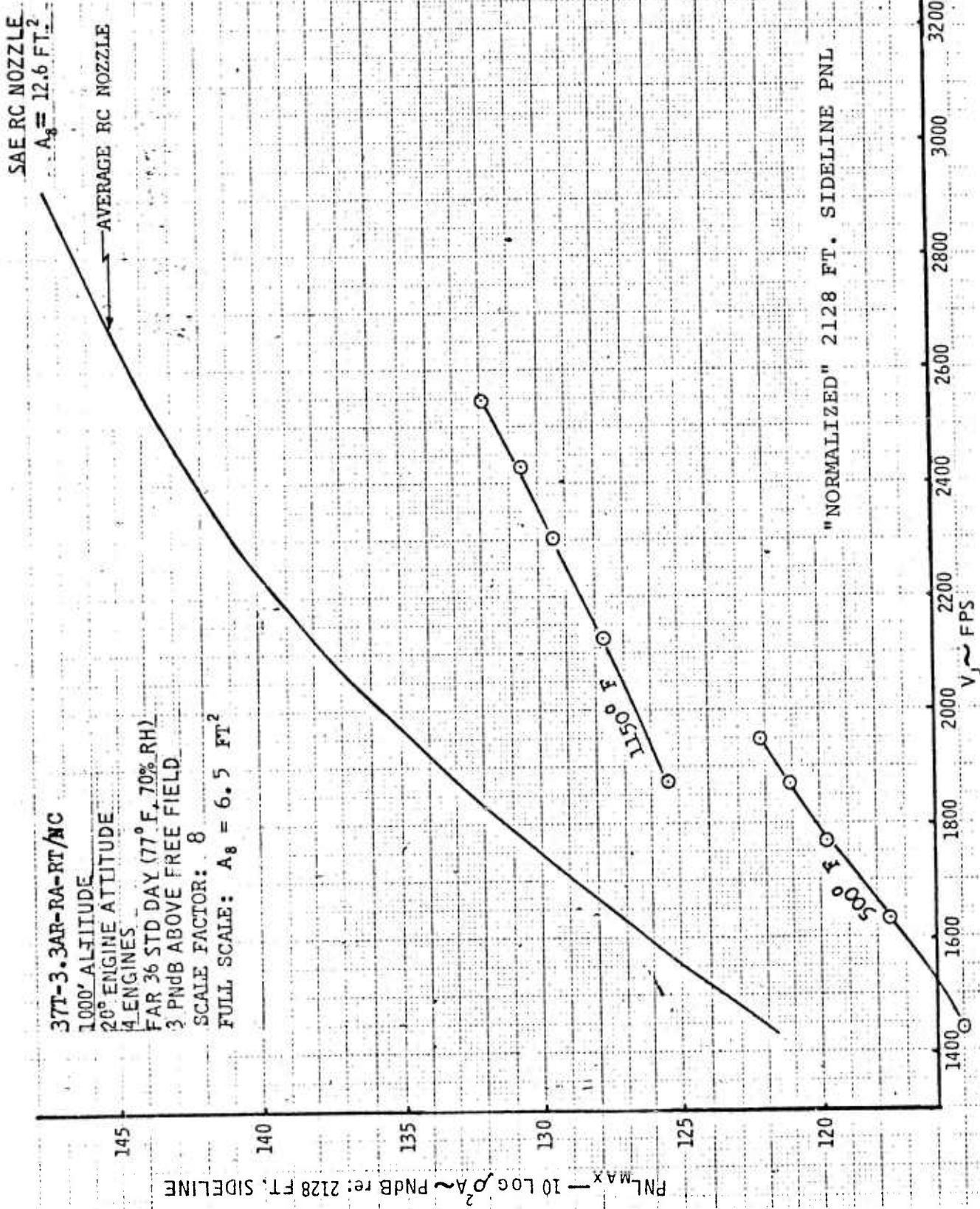
FREE FIELD VALUES

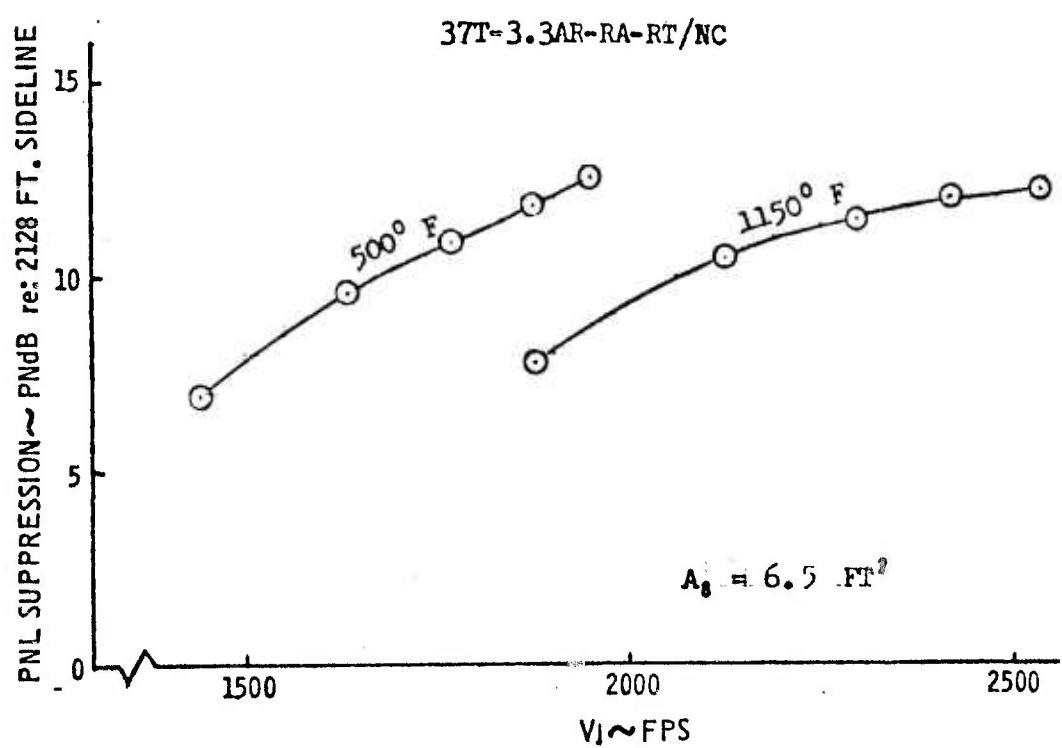


POINT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
▲	010	2.50	1150°F
◇	010	3.00	1150
○	010	3.50	1150
◎	010	4.00	1150

NOZZLE: 37T-3.3AR-RA-RT/NC

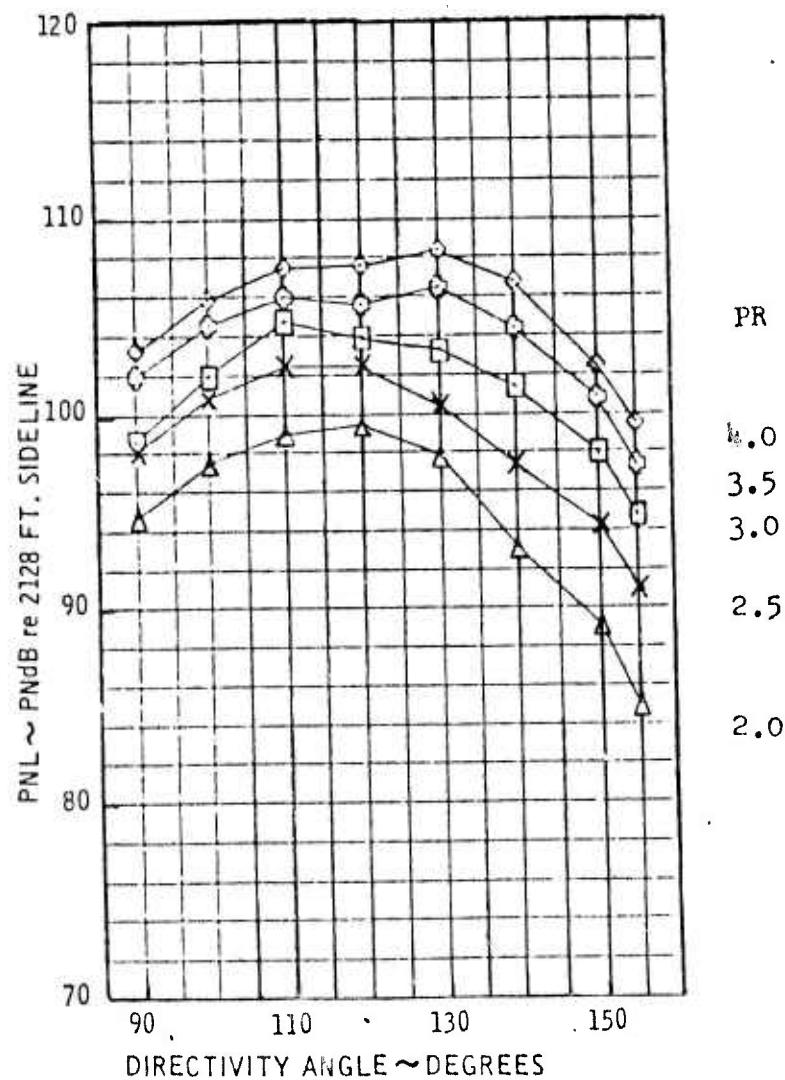
OASPL BEAM PATTERNS





PEAK PNL SUPPRESSION VALUES

NOZZLE: 37T-3.3AR-RA-RT/MC

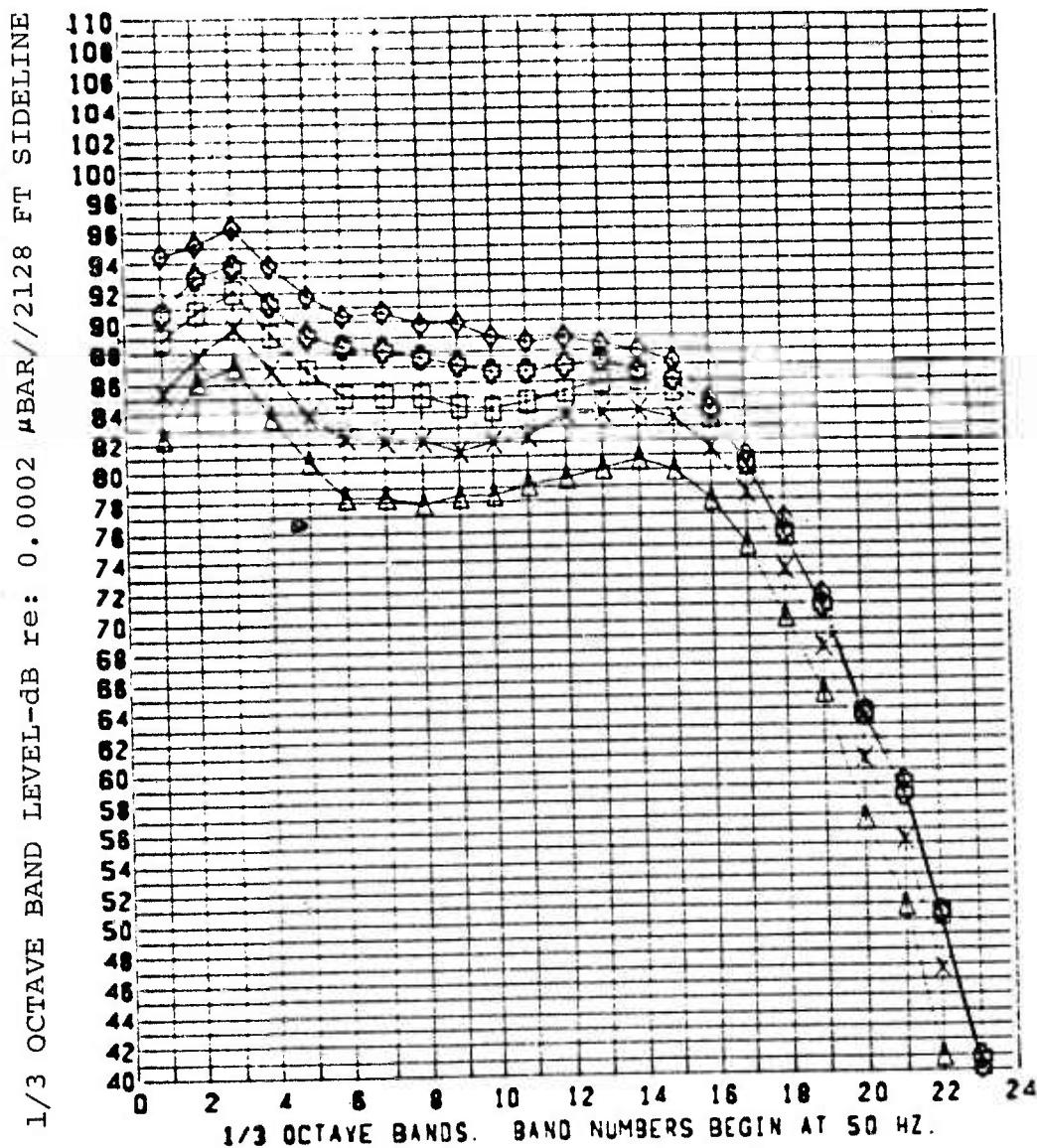


RUN 010
 $T_T = 1150^{\circ} F$ $A_B = 6.5 \text{ ft}^2$

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN:010

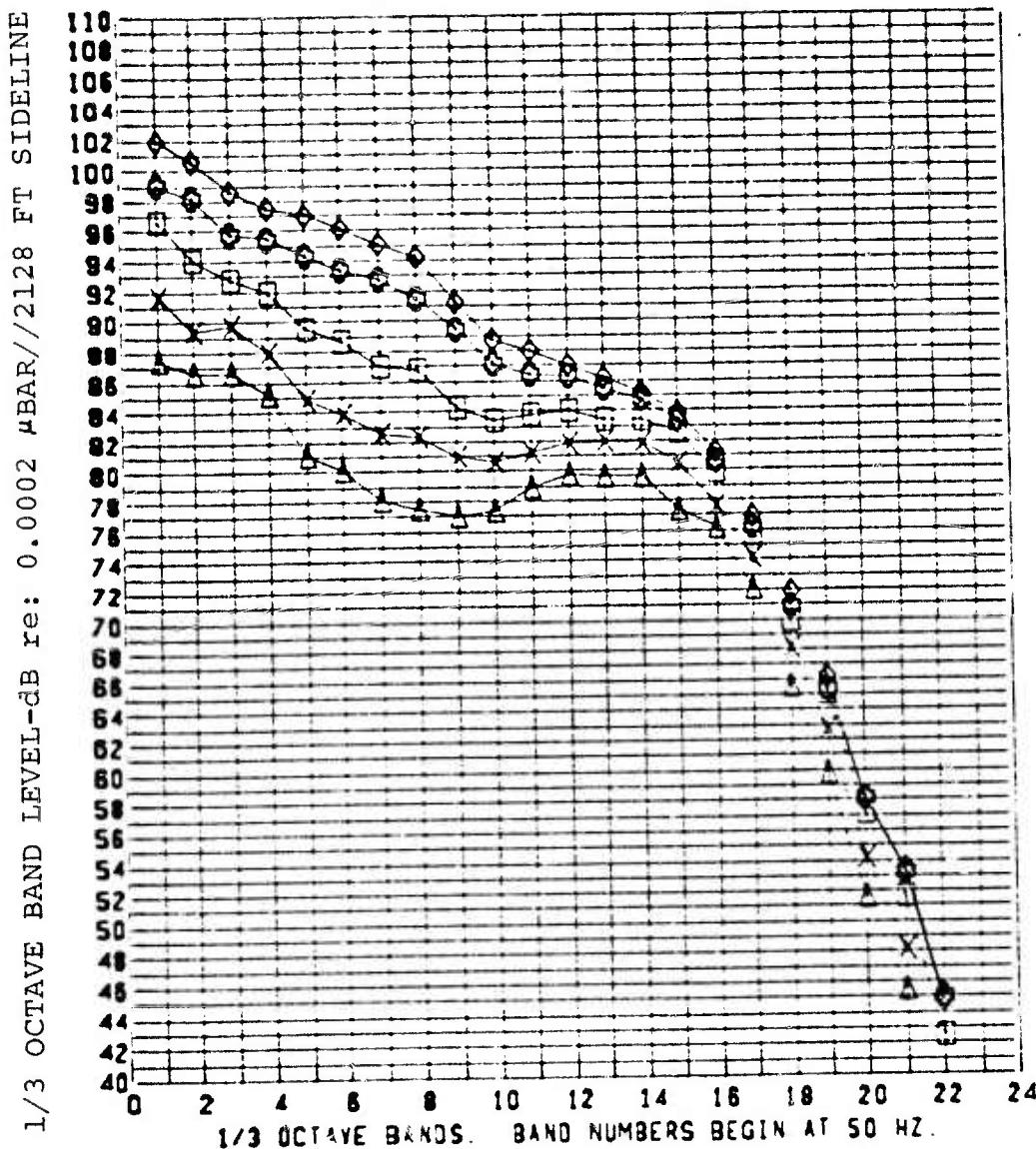
PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 3.5, \diamond 4.0

NOZZLE: 37T-3.3AR-RA-RT/NC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 010

PR = △ 2.0, X 2.5, □ 3.0, + 3.4, ◇ 3.7

NOZZLE: 37T-3.3AR-RA-RT/NC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°
re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 37T-3.3AR-RA-RT/NC

FACILITY: WALL ISOLATION FACILITY

DATE: January 20, 1973

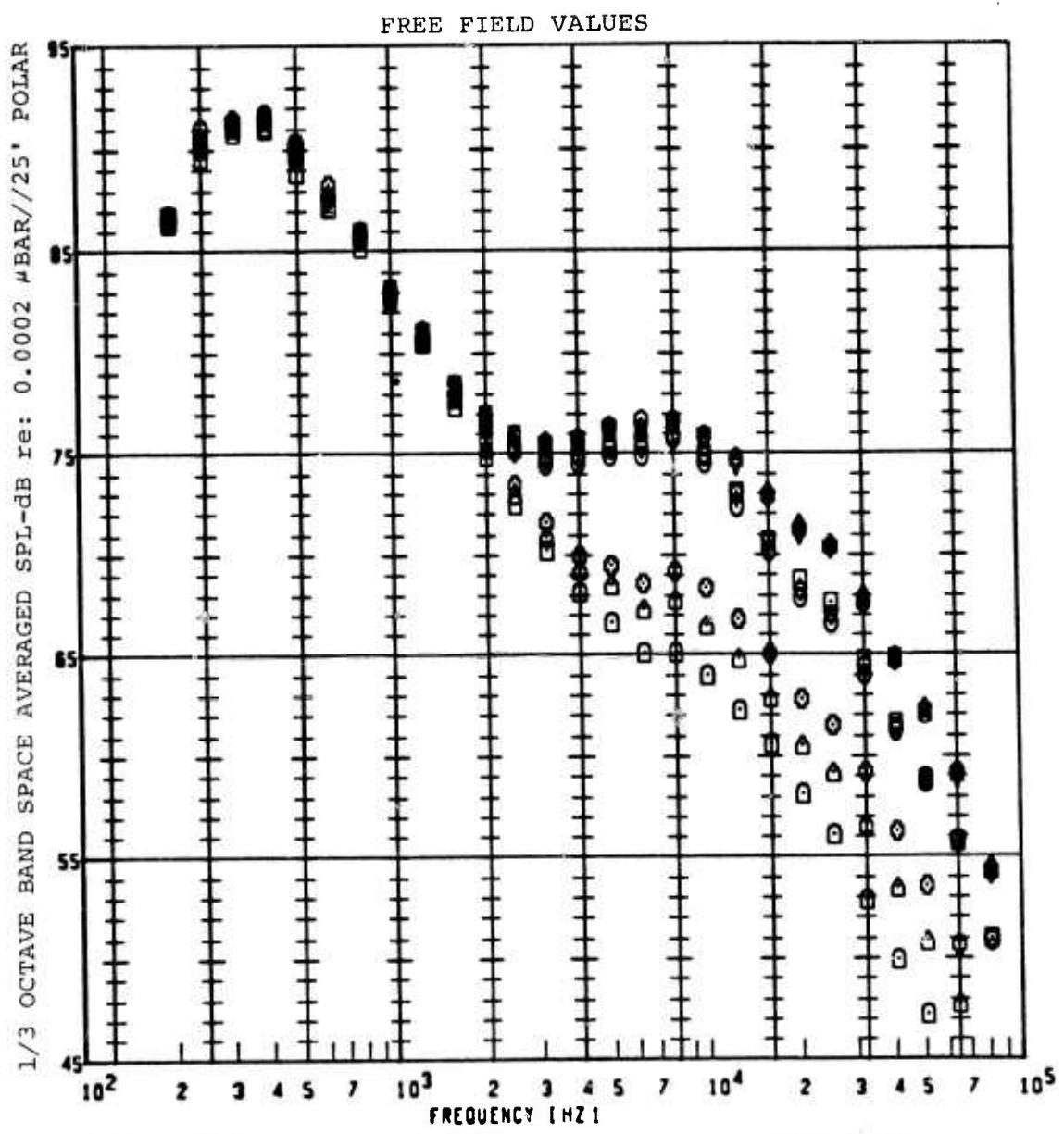
P_{AMB} = 30.06 in Hg **T_{AMB}** = 41°F **R.H.** = 85%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

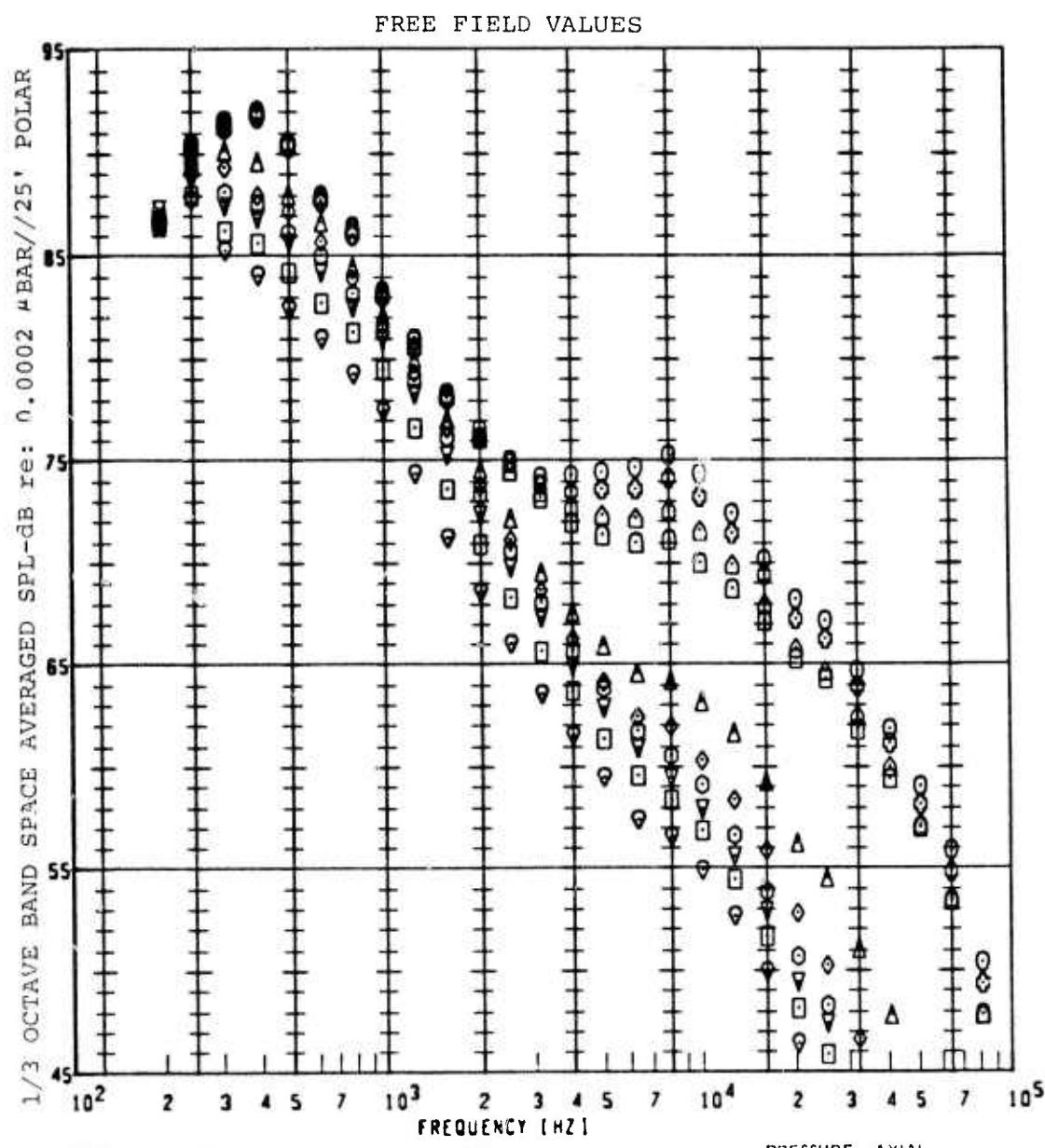
SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>AXIAL LOCATION</u>	<u>IRIS DIA.</u>	<u>REMARKS</u>	<u>REF.</u>
146	0.0 x/D	9.0 in.		
147	0.25	9.0		
148	0.50	9.0		
149	0.75	10.0		
150	1.00	14.0		
151	1.25	10.5		
152	1.50	10.5		
153	1.75	11.0		
154	2.00	11.0		
155	2.25	11.5		
156	2.50	11.5		
157	2.75	12.0		
158	3.0	13.0		
159	3.5	14.0		
160	4.0	15.0		
161	5.0	16.0		
162	6.0	18.0		
163	8.0	19.0		
164	10.0	21.0		
165	12.0	23.0		
166	14.0	35.0		
167	16.0	27.0		

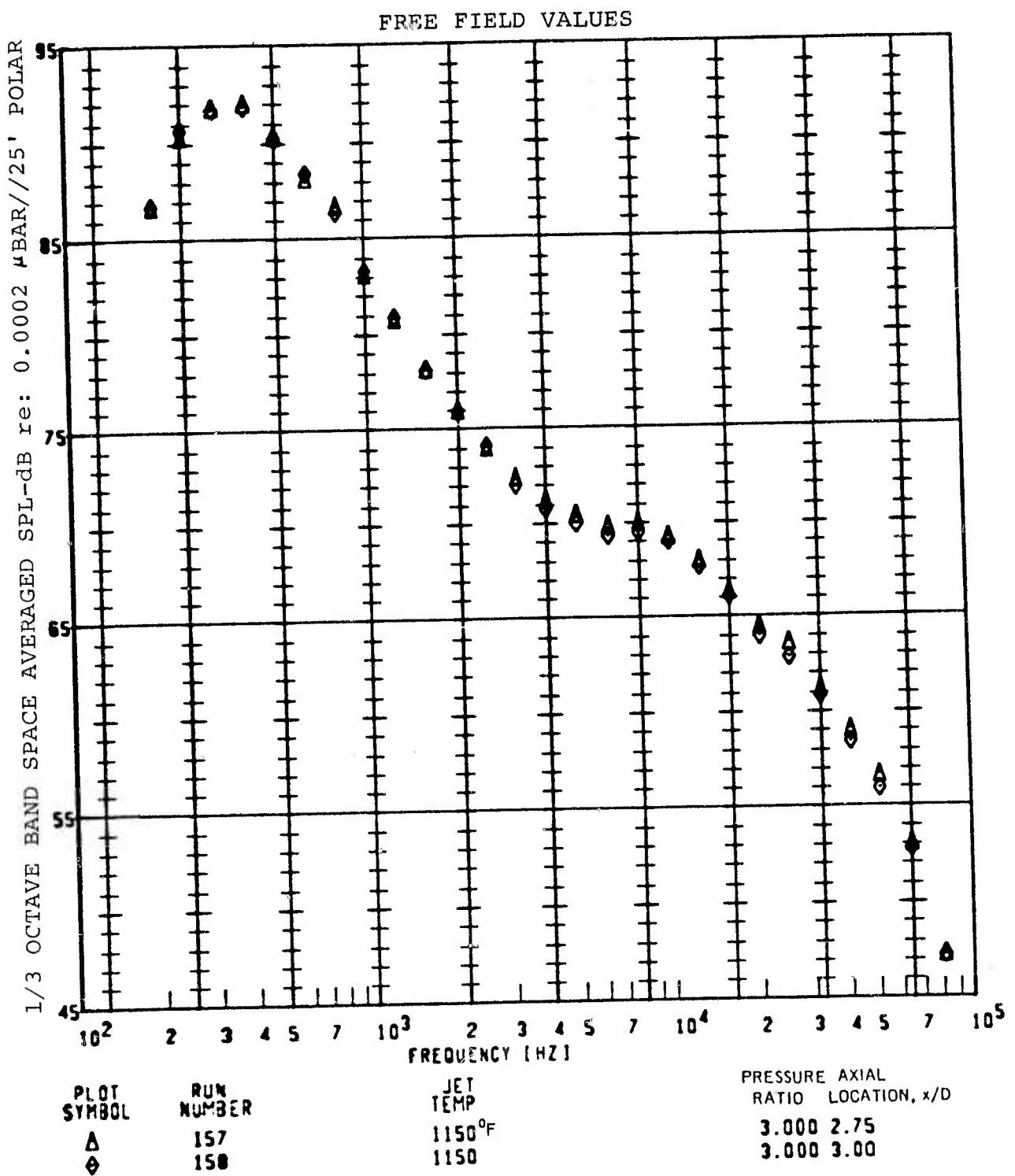
MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

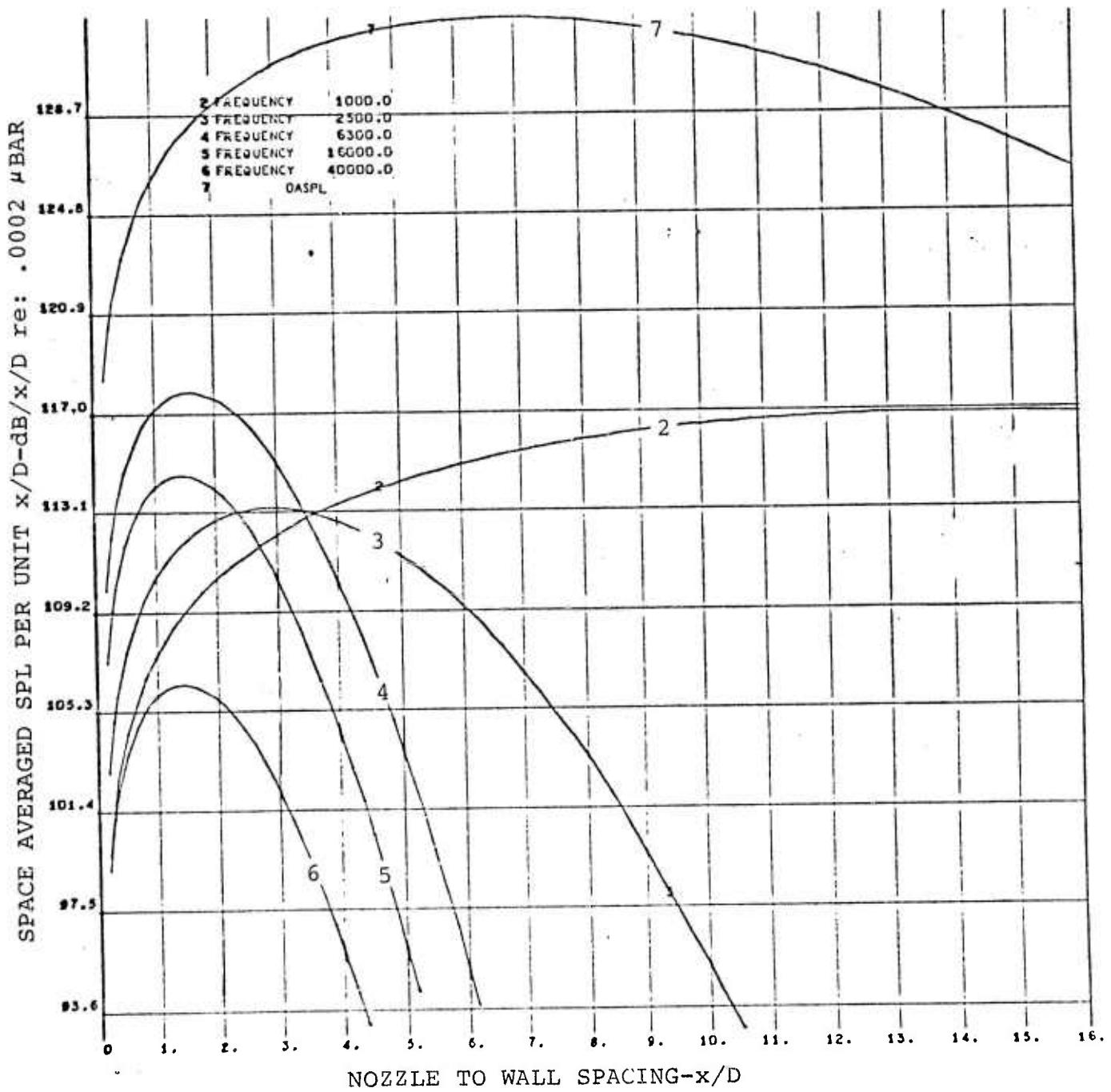


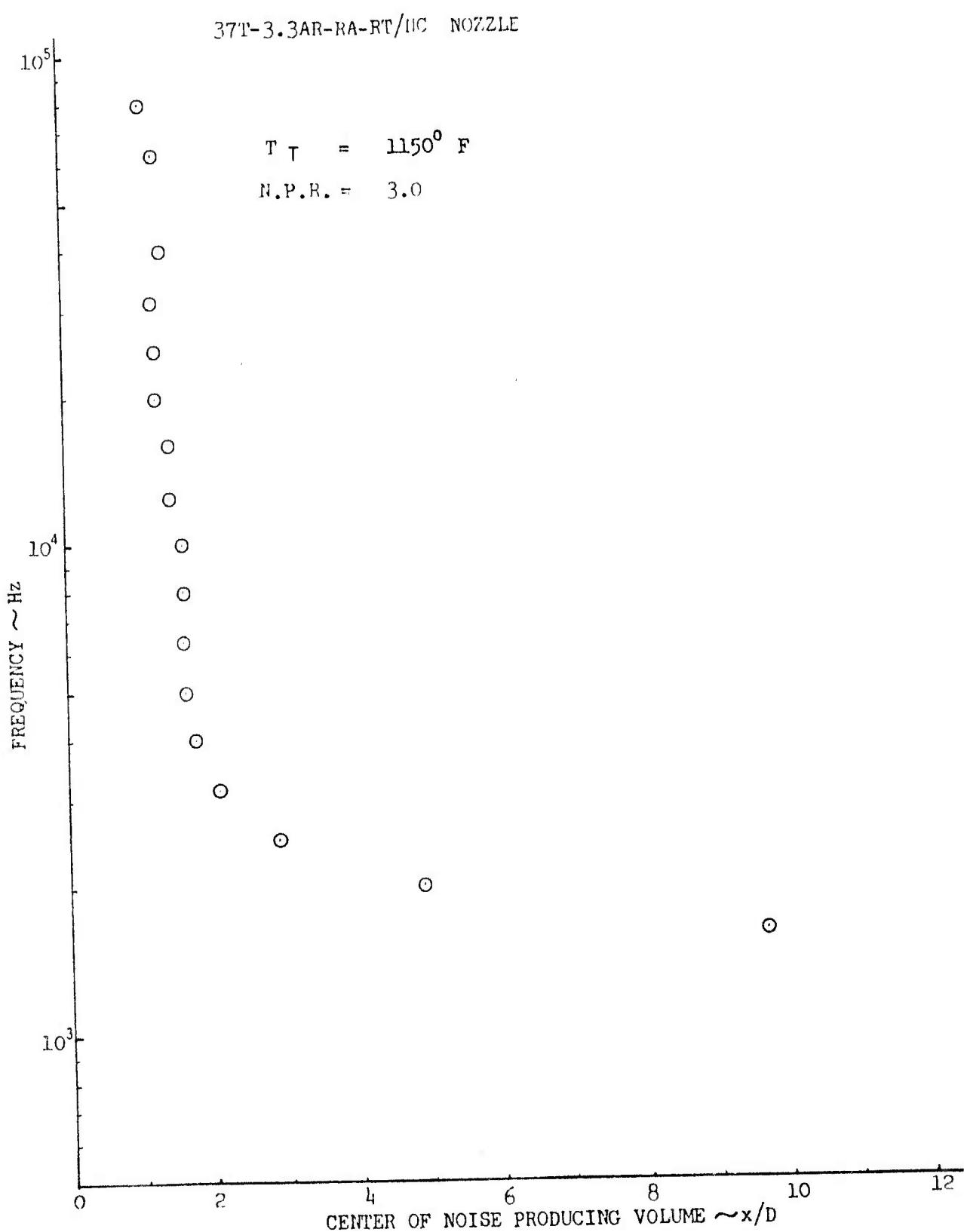
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	146	1150 °F	3.000	0.00
◊	147	1150		0.25
○	148	1150		0.50
□	149	1150		0.75
○	150	1150		1.00
○	151	1150		1.25
○	152	1150		1.50
○	159	1150		3.50
○	160	1150		4.00
○	181	1150		5.00

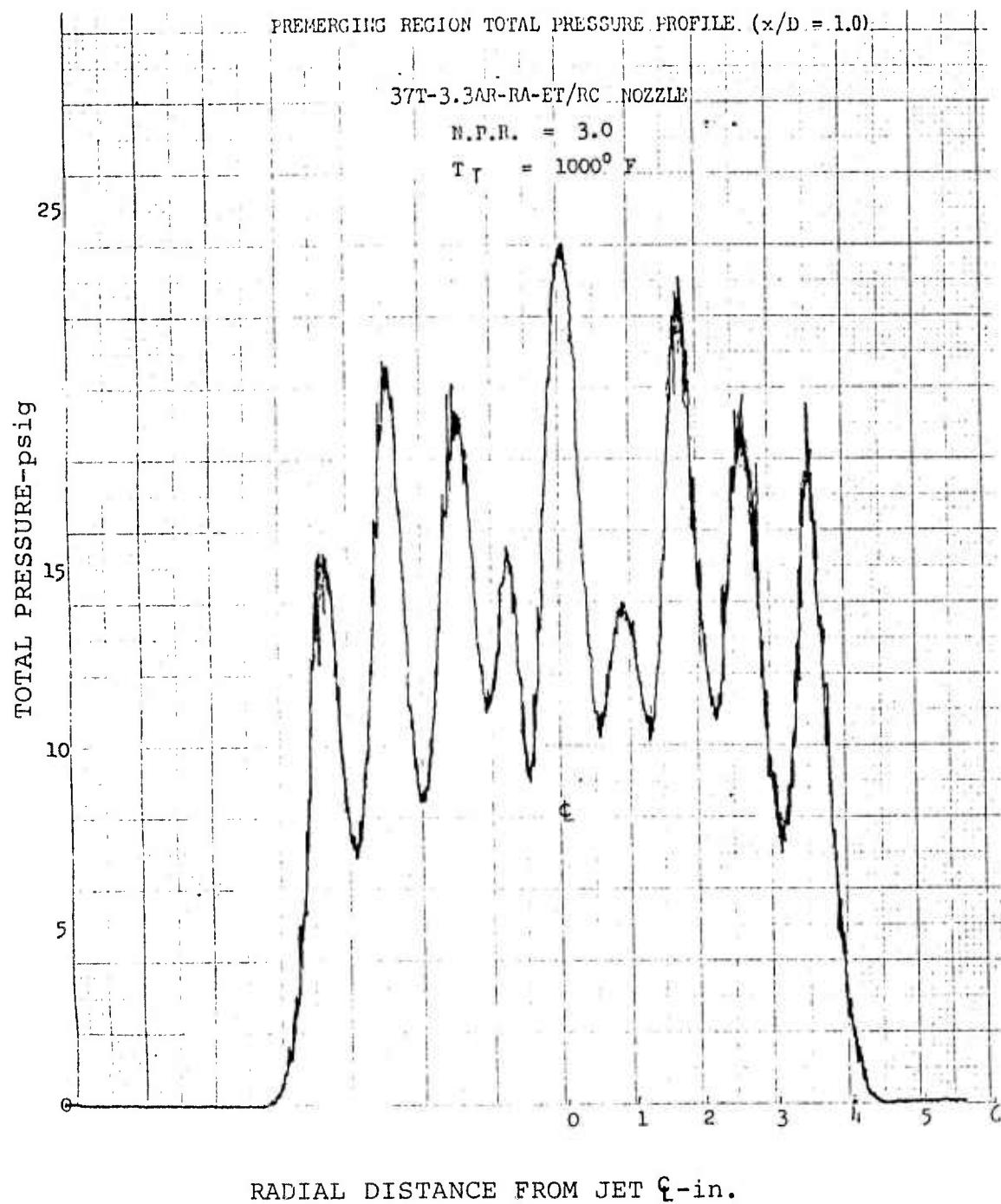


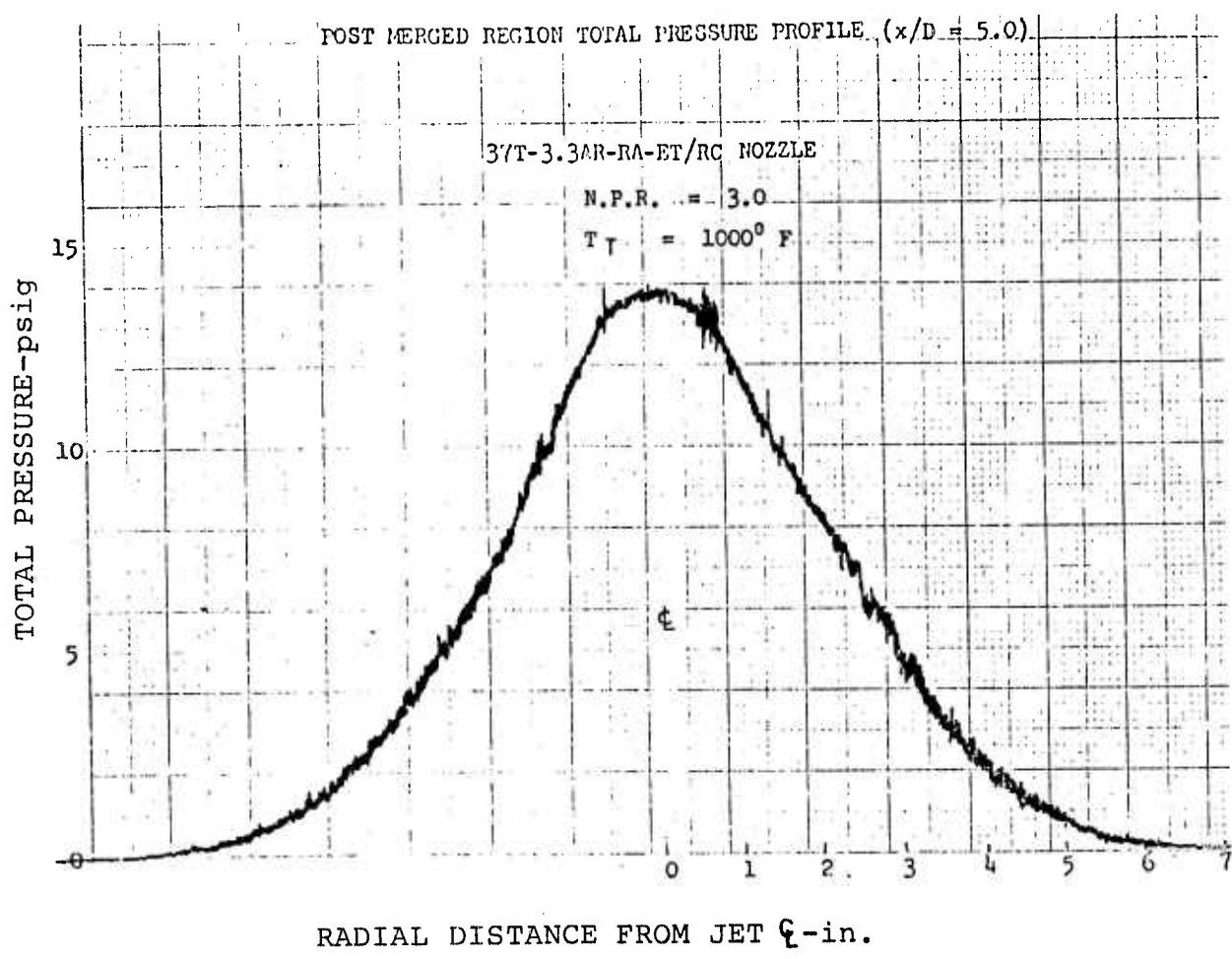
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	162	1150°F	3.0	6.00
◊	183	1150	3.0	8.00
○	164	1150	3.0	10.00
▽	165	1150	3.0	12.00
□	166	1150	3.0	14.00
◆	167	1150	3.0	16.00
○	153	1150	3.0	1.75
○	154	1150	3.0	2.00
○	155	1150	3.0	2.25
○	156	1150	3.0	2.50

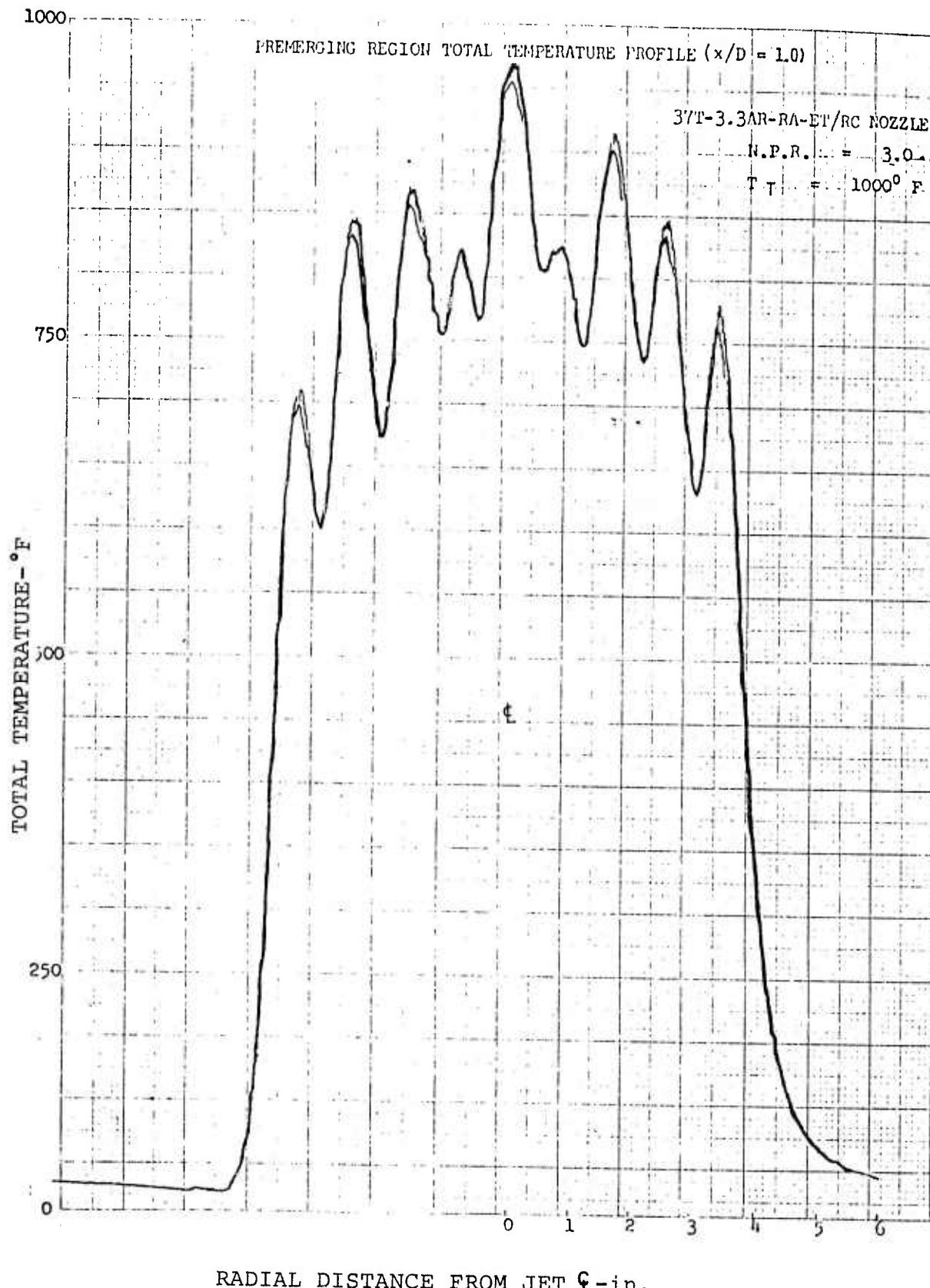


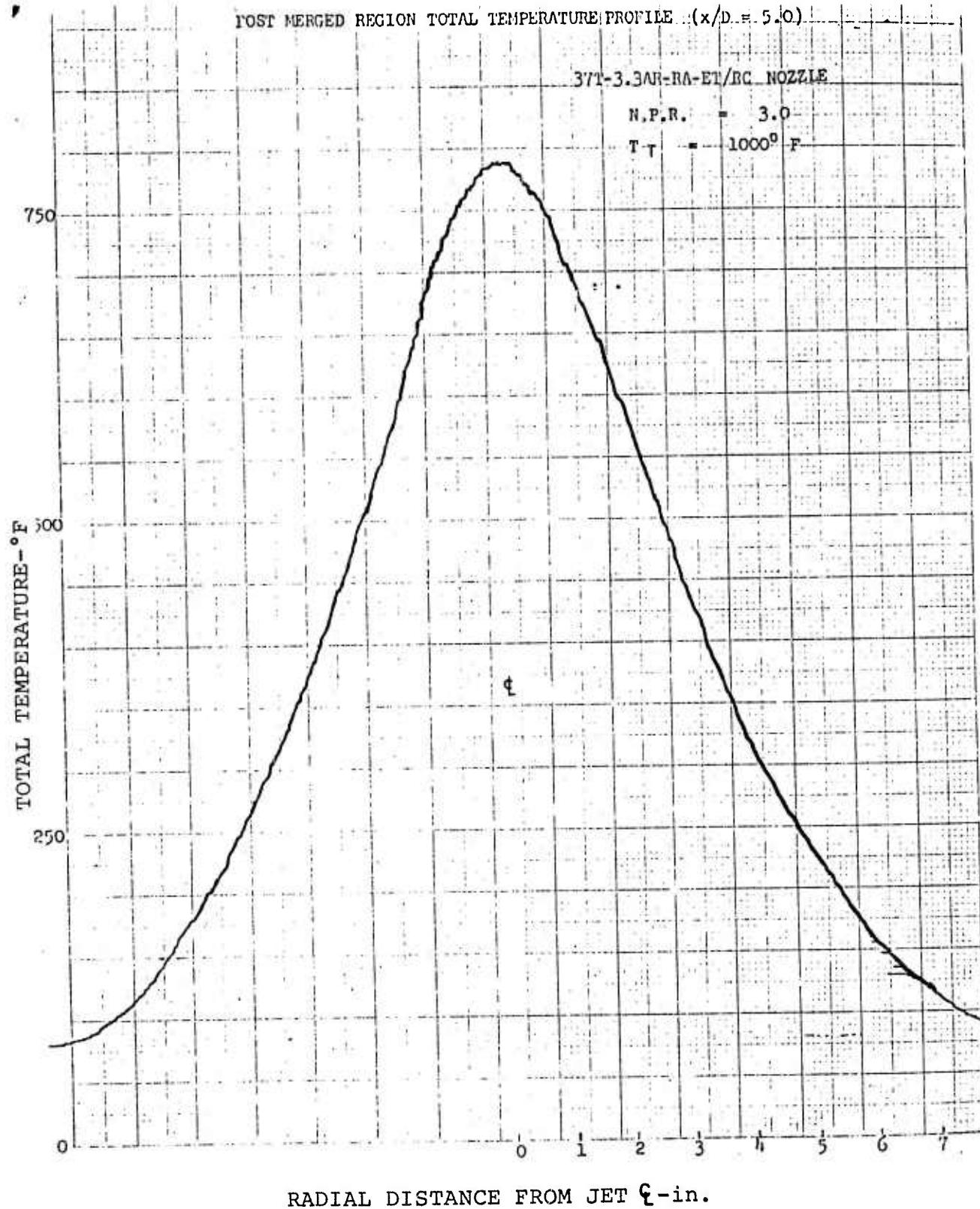


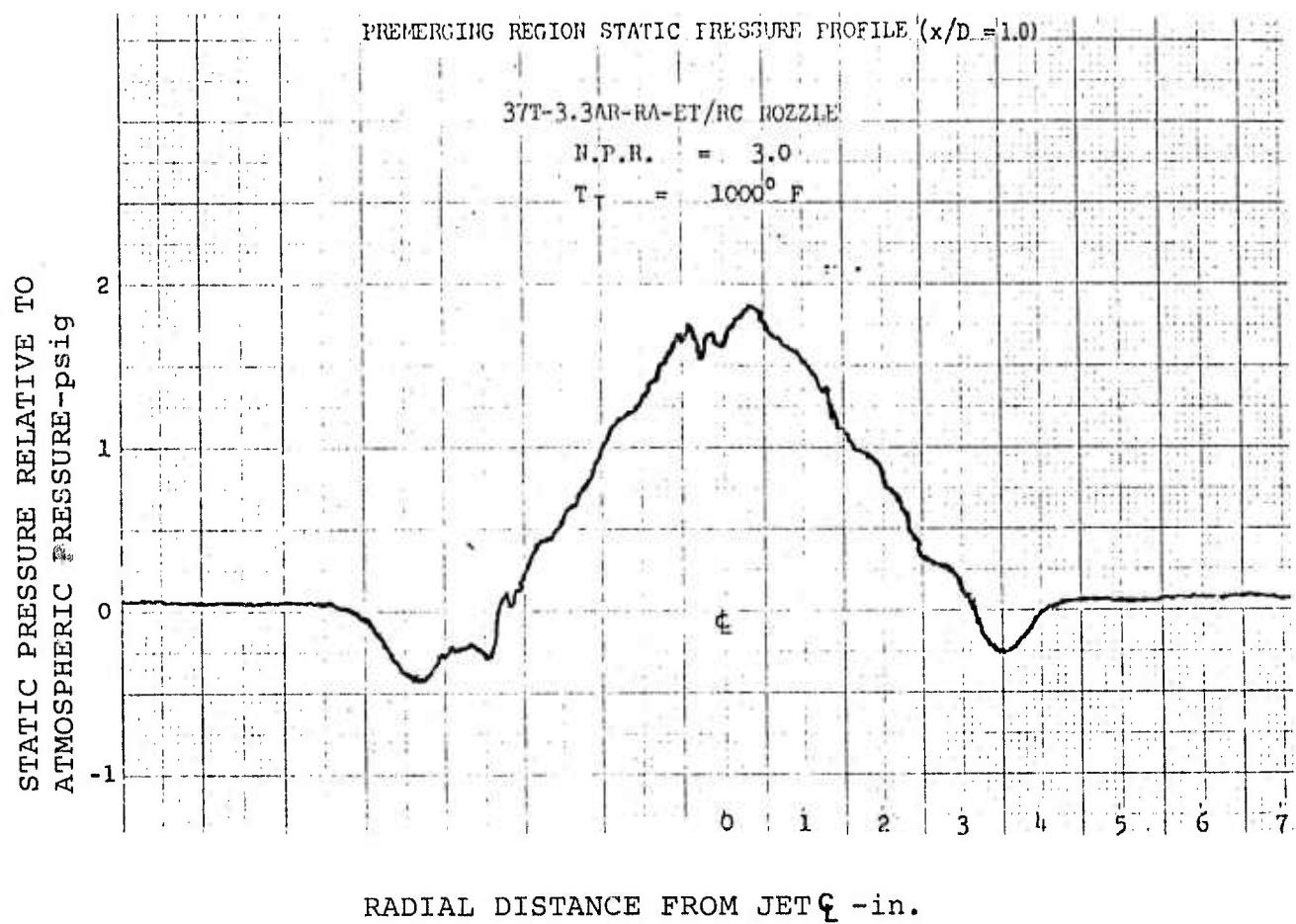


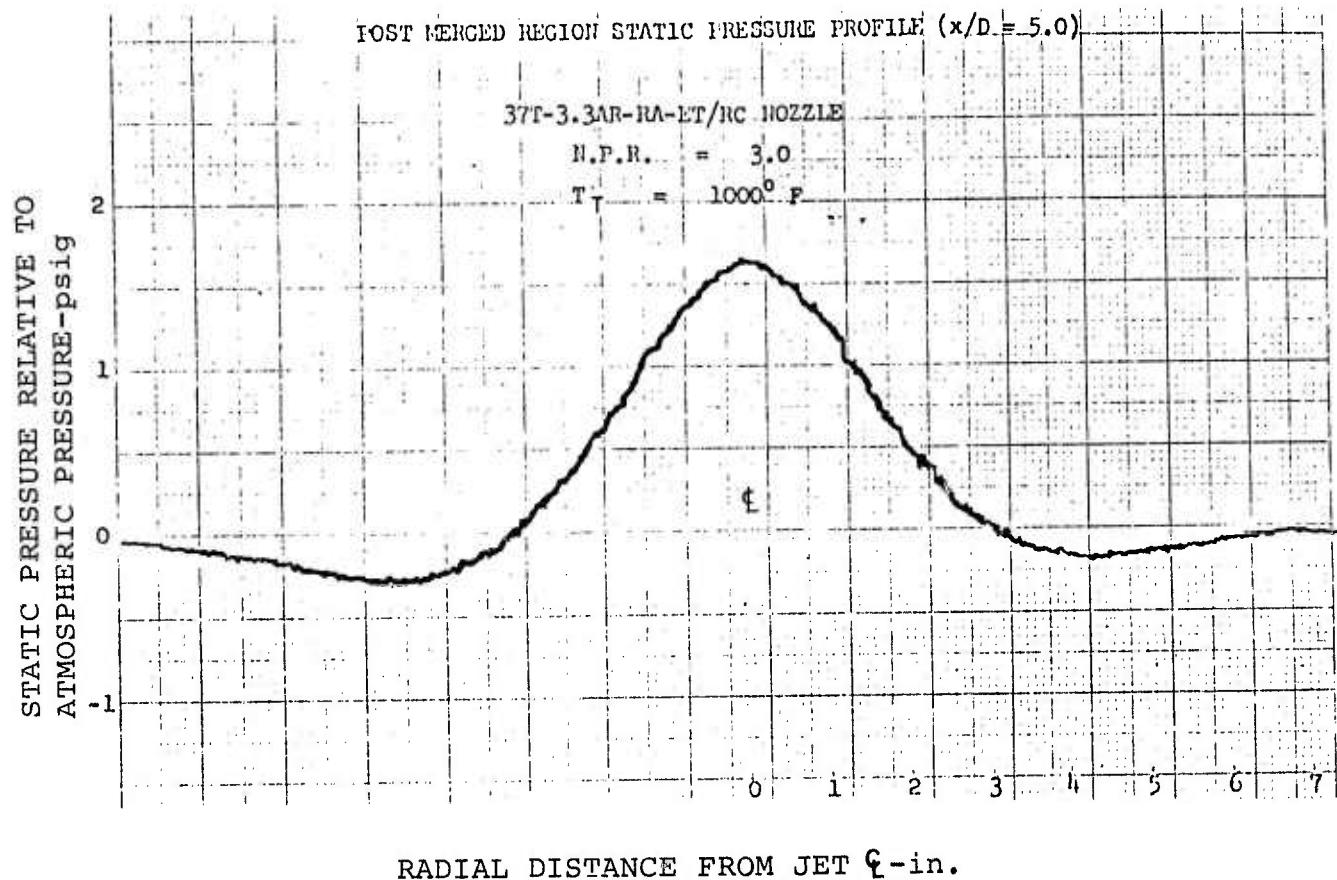






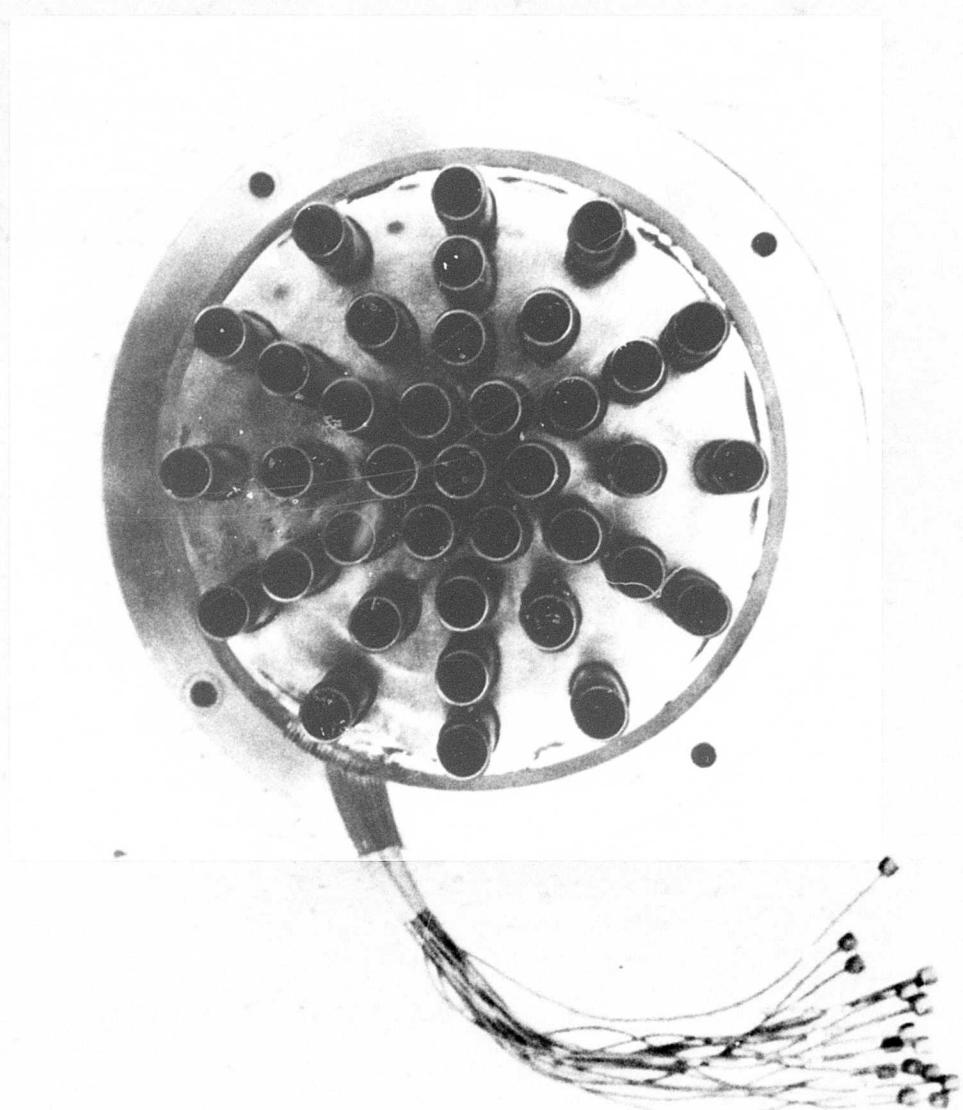








37T-4.5AR-RA-ET/RC NOZZLE

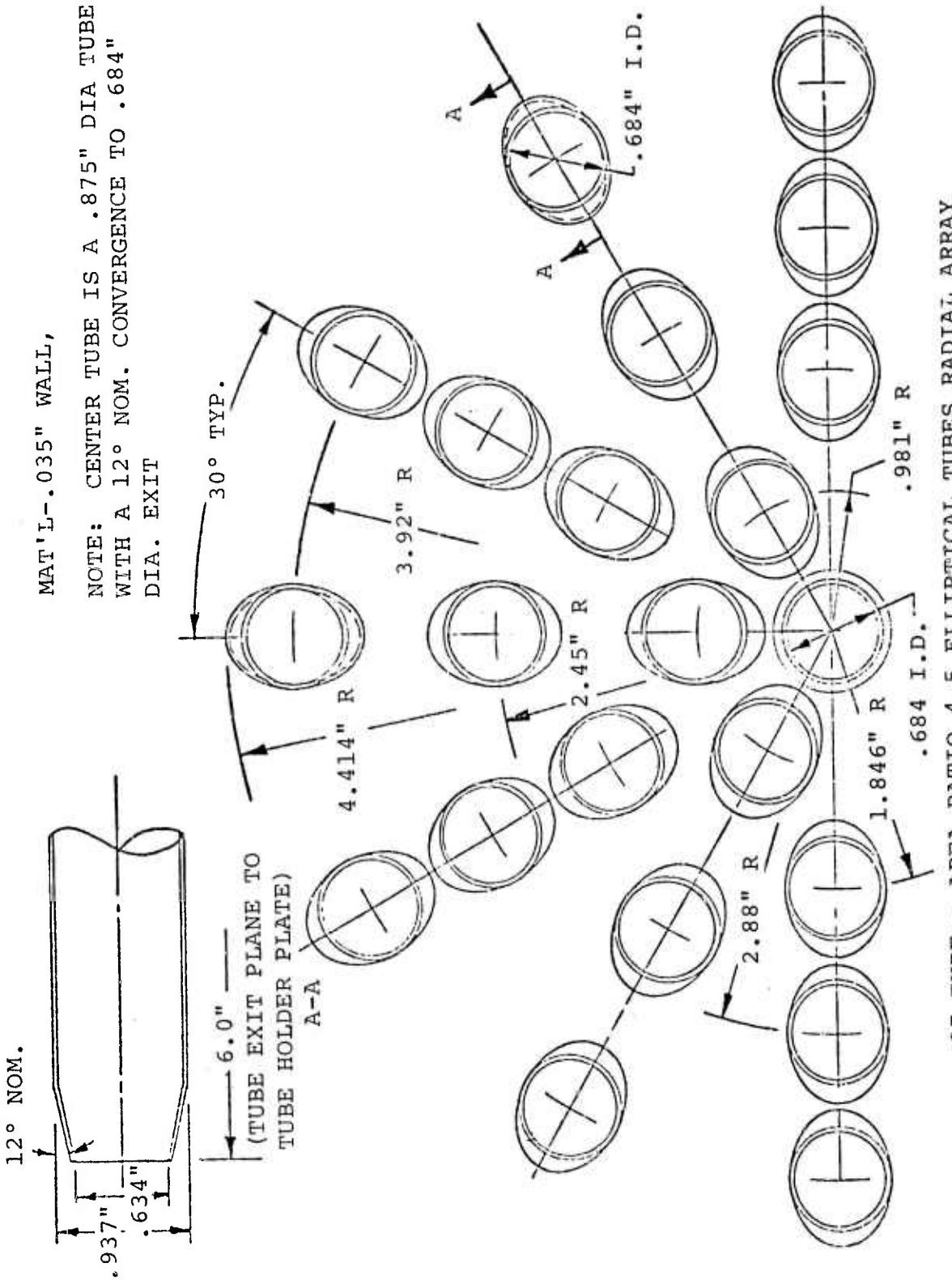


37T-4.5AR-RA-ET/RC NOZZLE

120 NOM.

MAT'L - .035" WALL,

NOTE: CENTER TUBE IS A .875" DIA TUBE
WITH A 12° NOM. CONVERGENCE TO .684"
DIA. EXIT



TEST CONDITIONS

NOZZLE: 37T-4.5AR-RA-ET/RC

FACILITY: HNTF

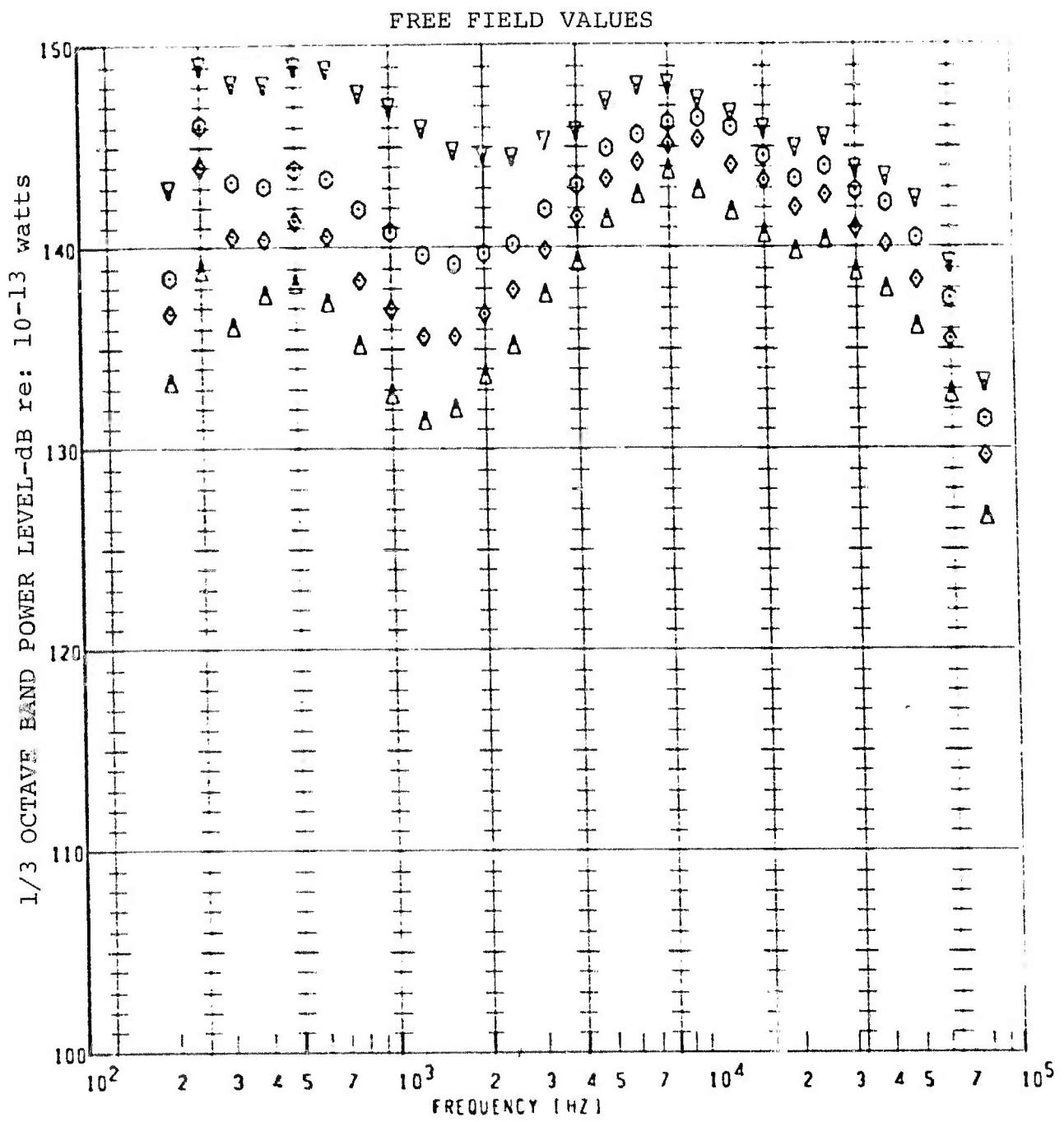
DATE: 1-26-73

T_{AMB} = 41.4°F **R.H.** = 80%

SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
215	2.0	1150°F	1875 fps	3" tube lengths	
"	2.5	"	2126		
"	3.0	"	2303		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

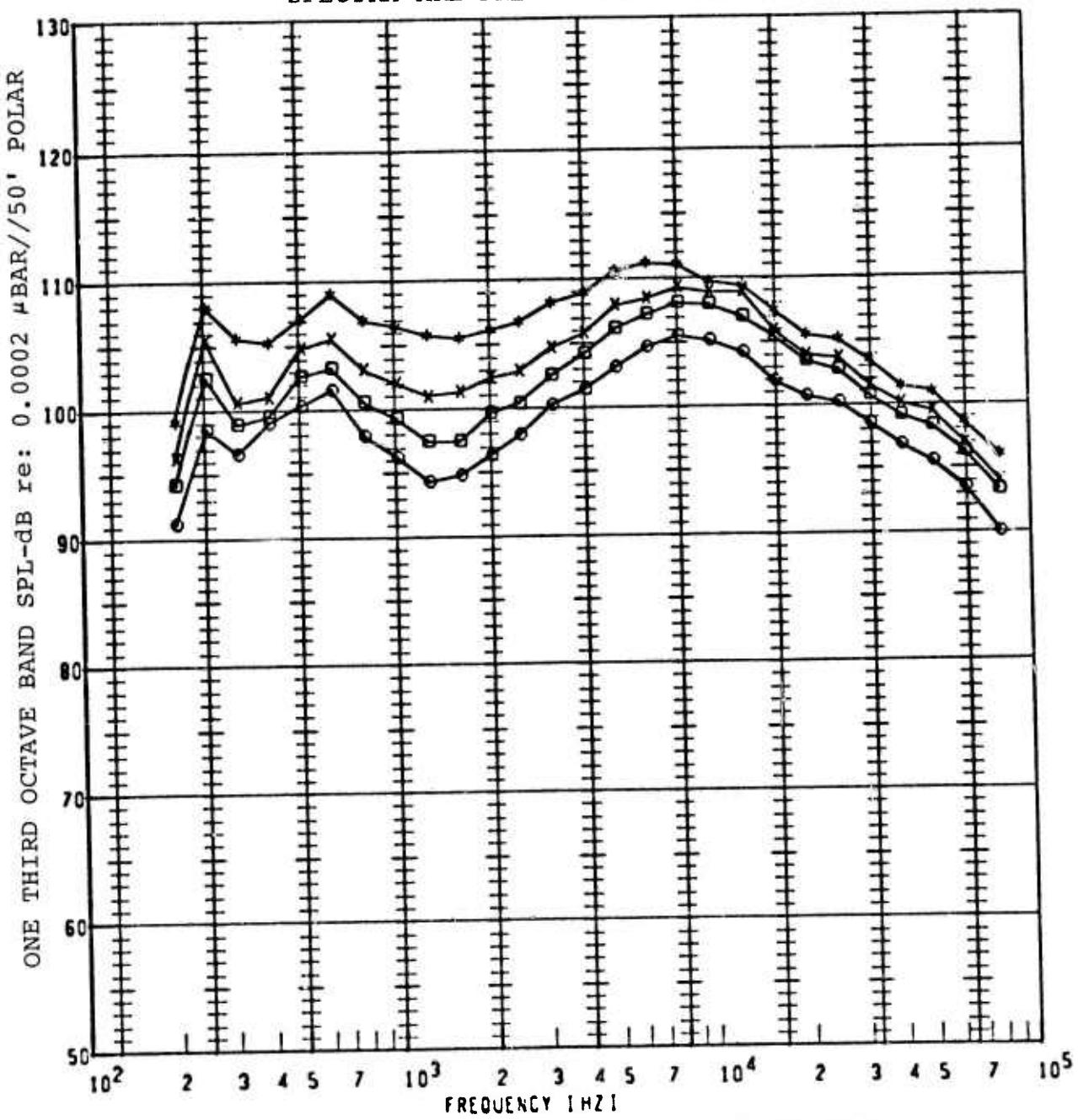


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	215	2.00	1150°F
◊	215	2.50	1150
○	215	3.00	1150
▽	215	4.00	1150

NOZZLE: 37T-4.5AR-RA-ET/RC

JET NOISE POWER SPECTRA

SPECTRA ARE FREE FIELD + 6dB

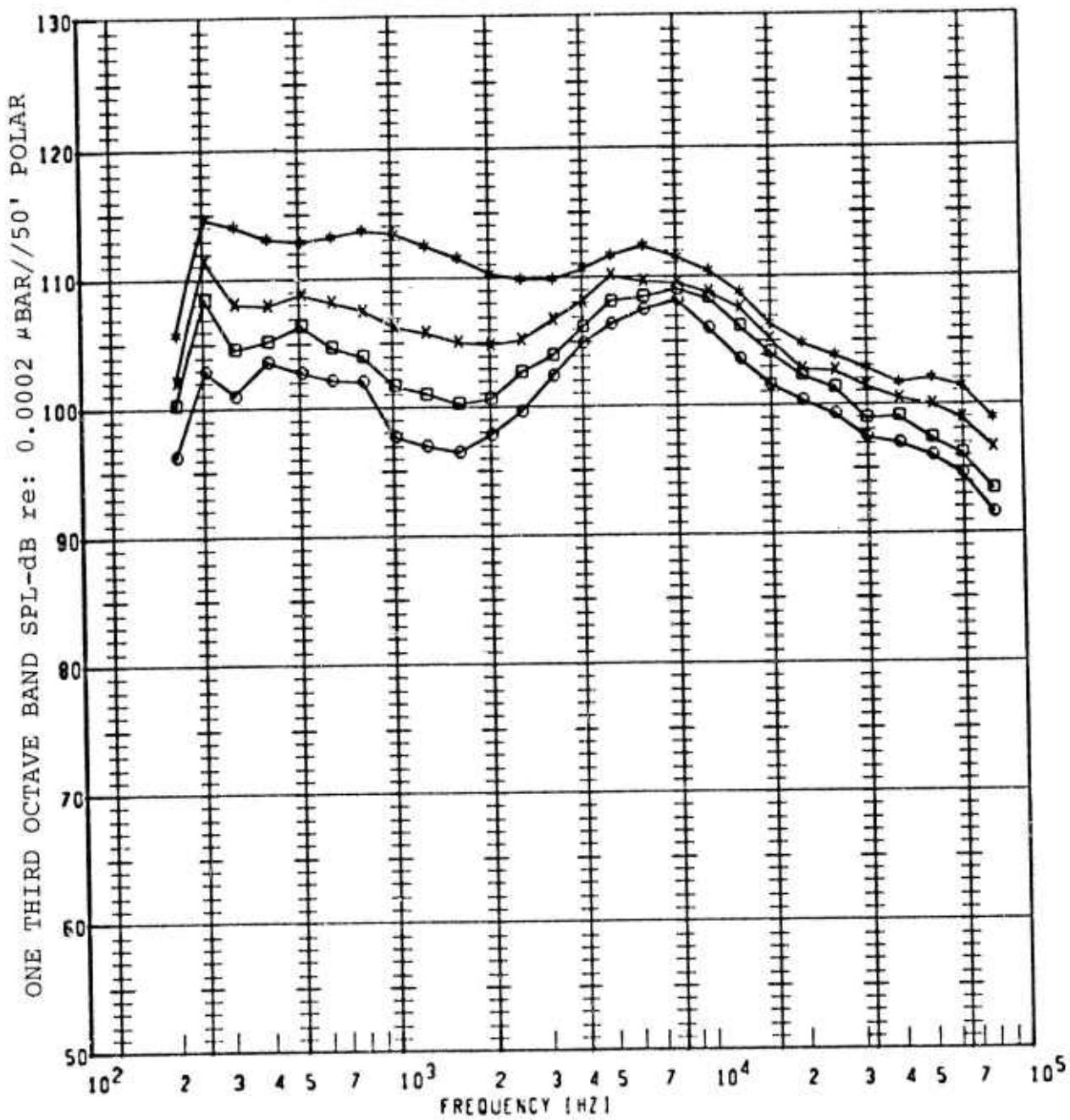


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL (dB)
○	215G	1150°F	2.000	110°	SOFP	114.7
□	215G	1150	2.500		SOFP	117.4
×	215G	1150	3.000		SOFP	119.0
*	215G	1150	4.000	↓	SOFP	121.5

NOZZLE: 37T-4.5AR-RA-ET/RC

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

SPECTRA ARE FREE FIELD + 6dB

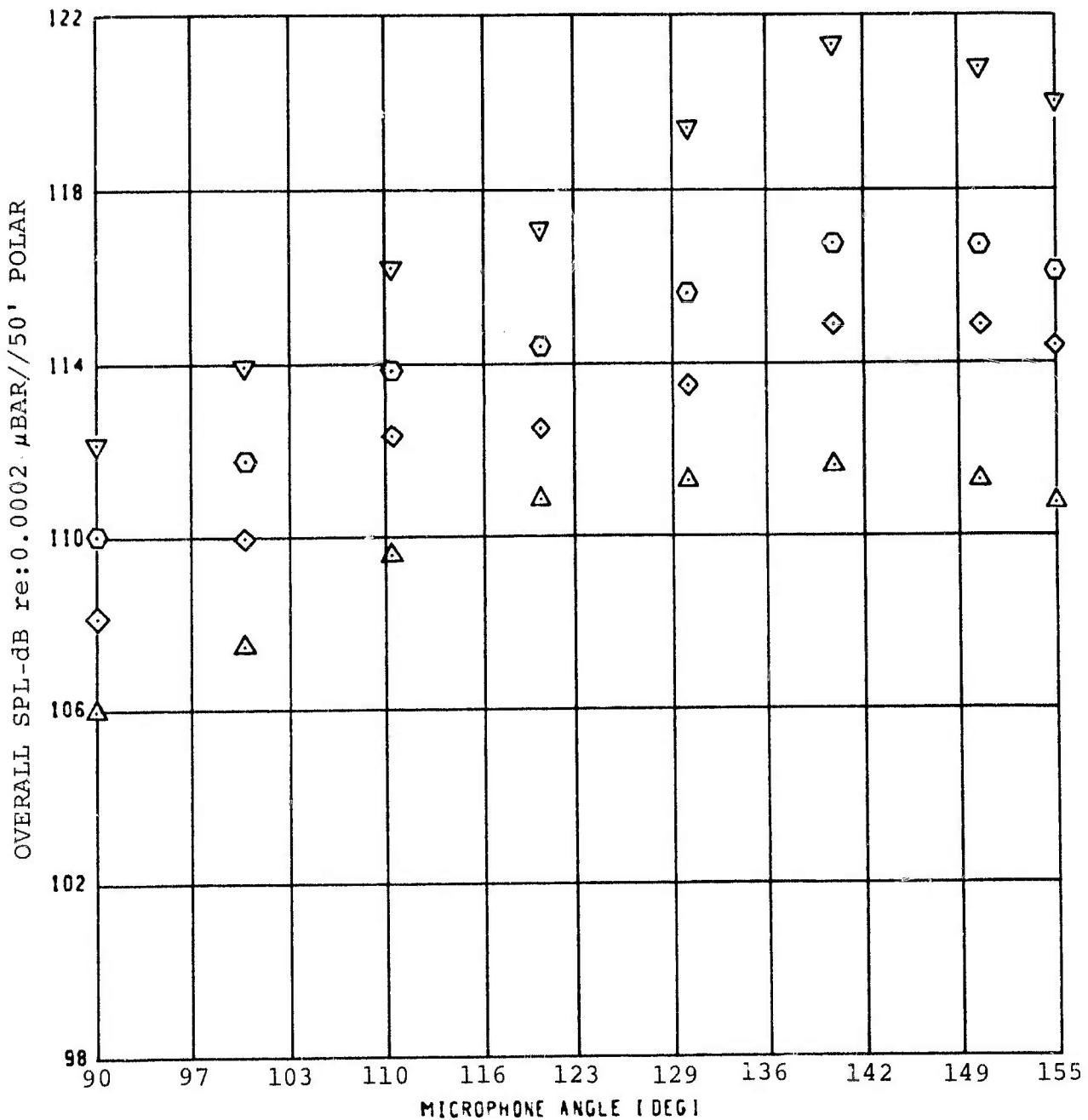


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL
○	215G	1150°F	2.000	130°	50FP	116.7
□	215G	1150	2.500		50FP	118.9
×	215G	1150	3.000		50FP	121.1
*	215G	1150	4.000	↓	50FP	125.1

NOZZLE: 37T-4.5AR-RA-ET/RC

MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS

FREE FIELD VALUES



PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	215	2.00	1150°F
◊	215	2.50	1150
○	215	3.00	1150
▽	215	4.00	1150

NOZZLE: 37T-4.5AR-RA-ET/RC

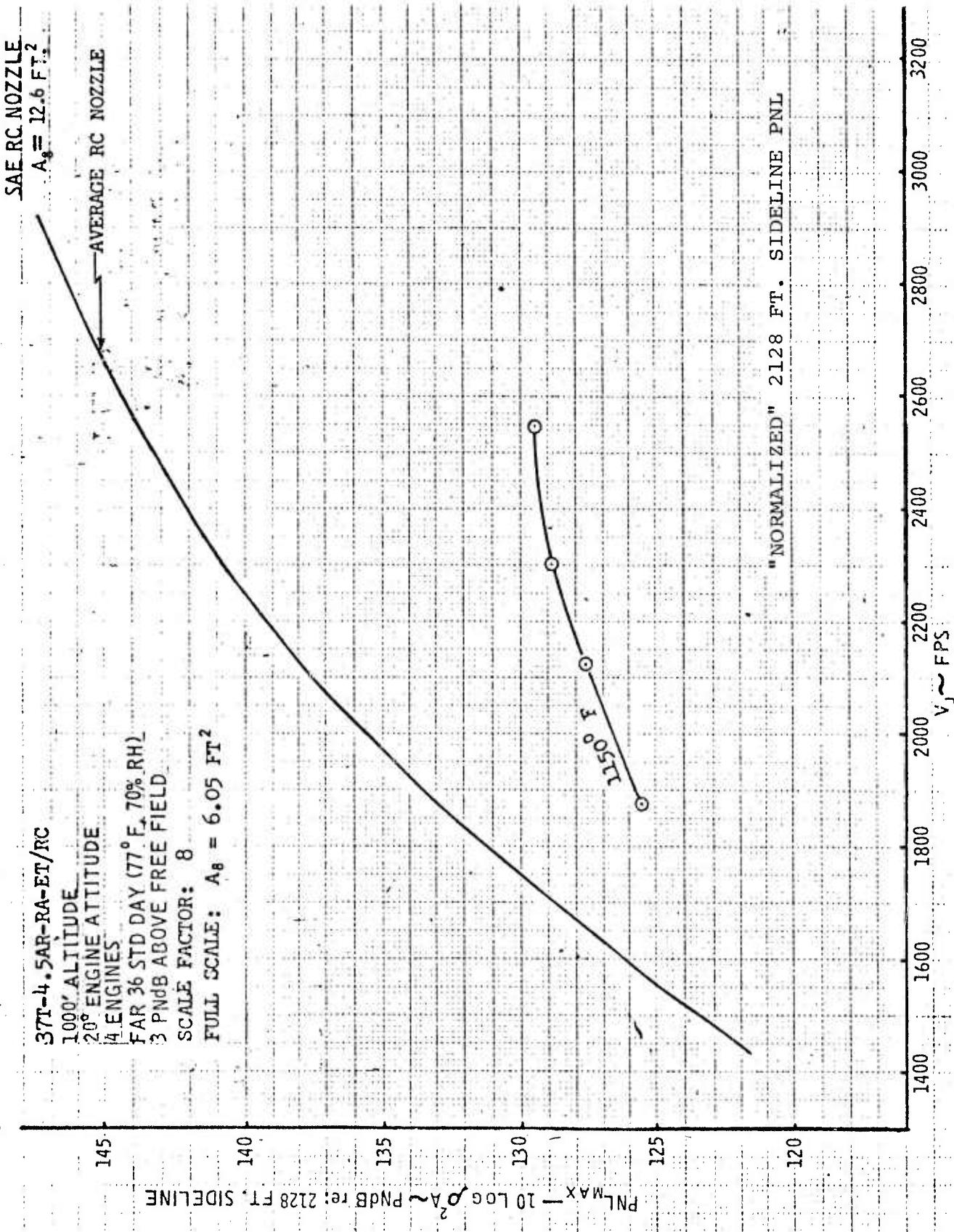
OASPL BEAM PATTERNS

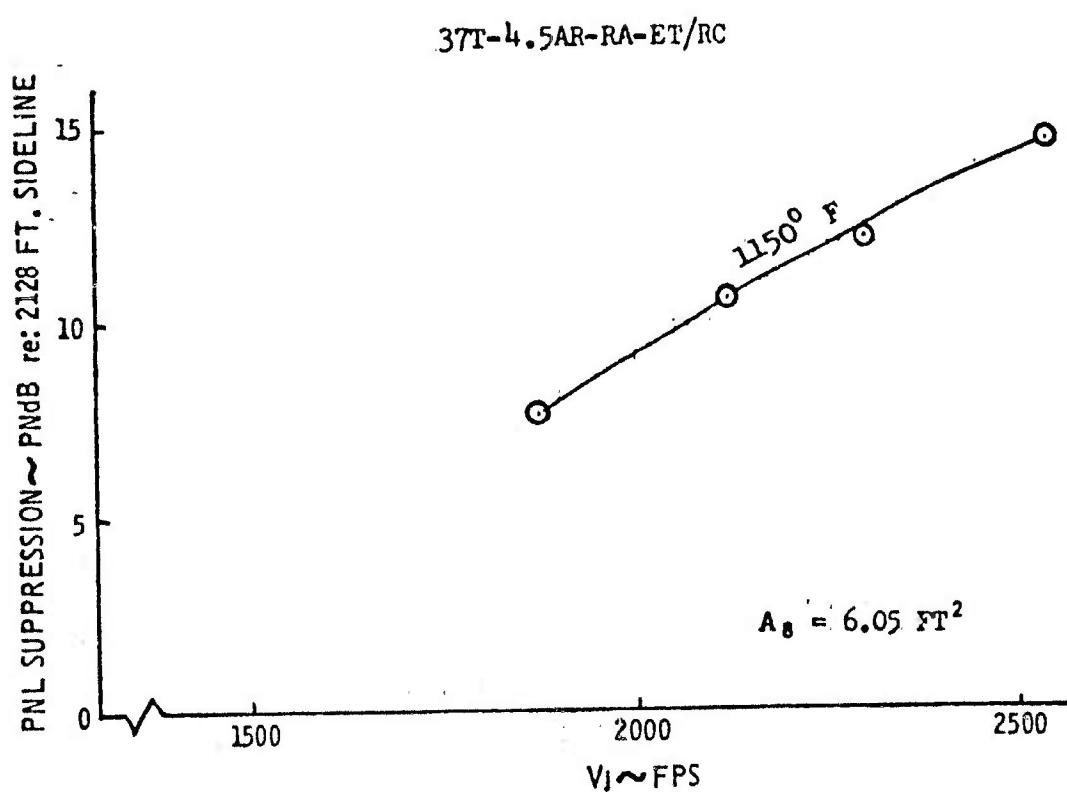
SAE RC NOZZLE

$$A_g = 12.6 \text{ FT}^2$$

AVERAGE RC NOZZLE

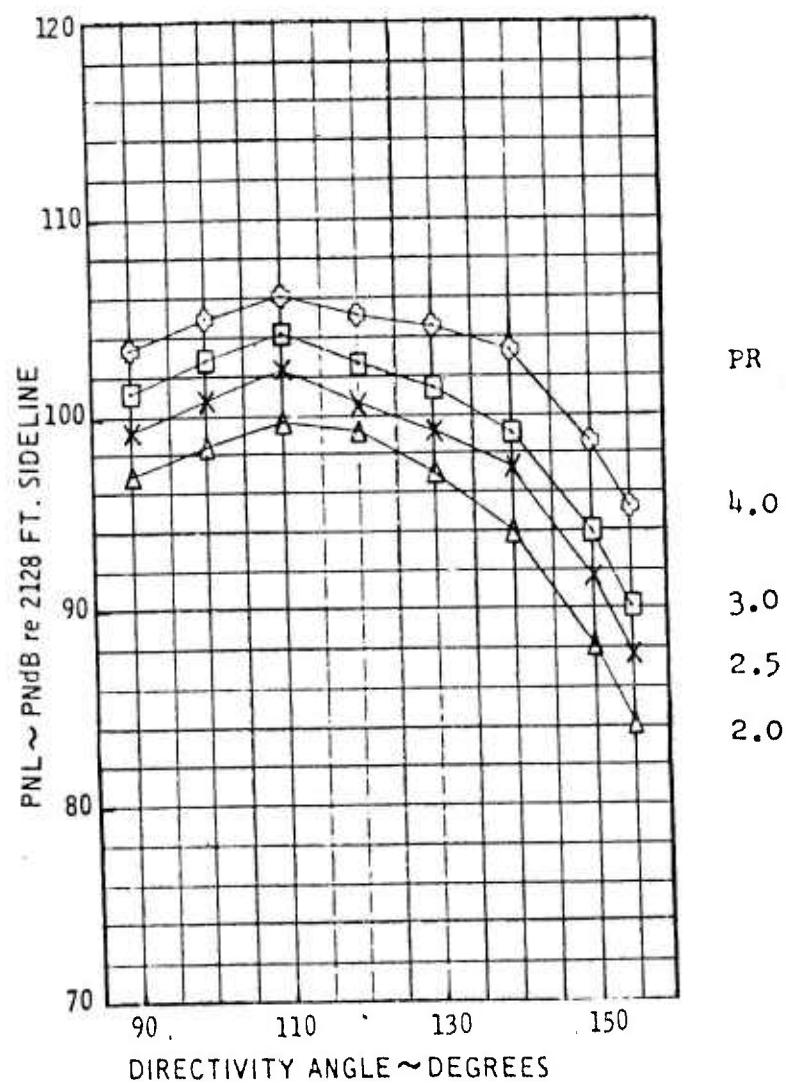
37T-4.5AR-RA-ET/RC
1000' ALTITUDE
20° ENGINE ATTITUDE
4 ENGINES
FAR 36 STD DAY (77° F, 70% RH)
3 PNdB ABOVE FREE FIELD
SCALE FACTOR: 8
FULL SCALE: $A_g = 6.05 \text{ FT}^2$





PEAK PNL SUPPRESSION VALUES

NOZZLE: 37T-4.5AR-RA-ET/RC

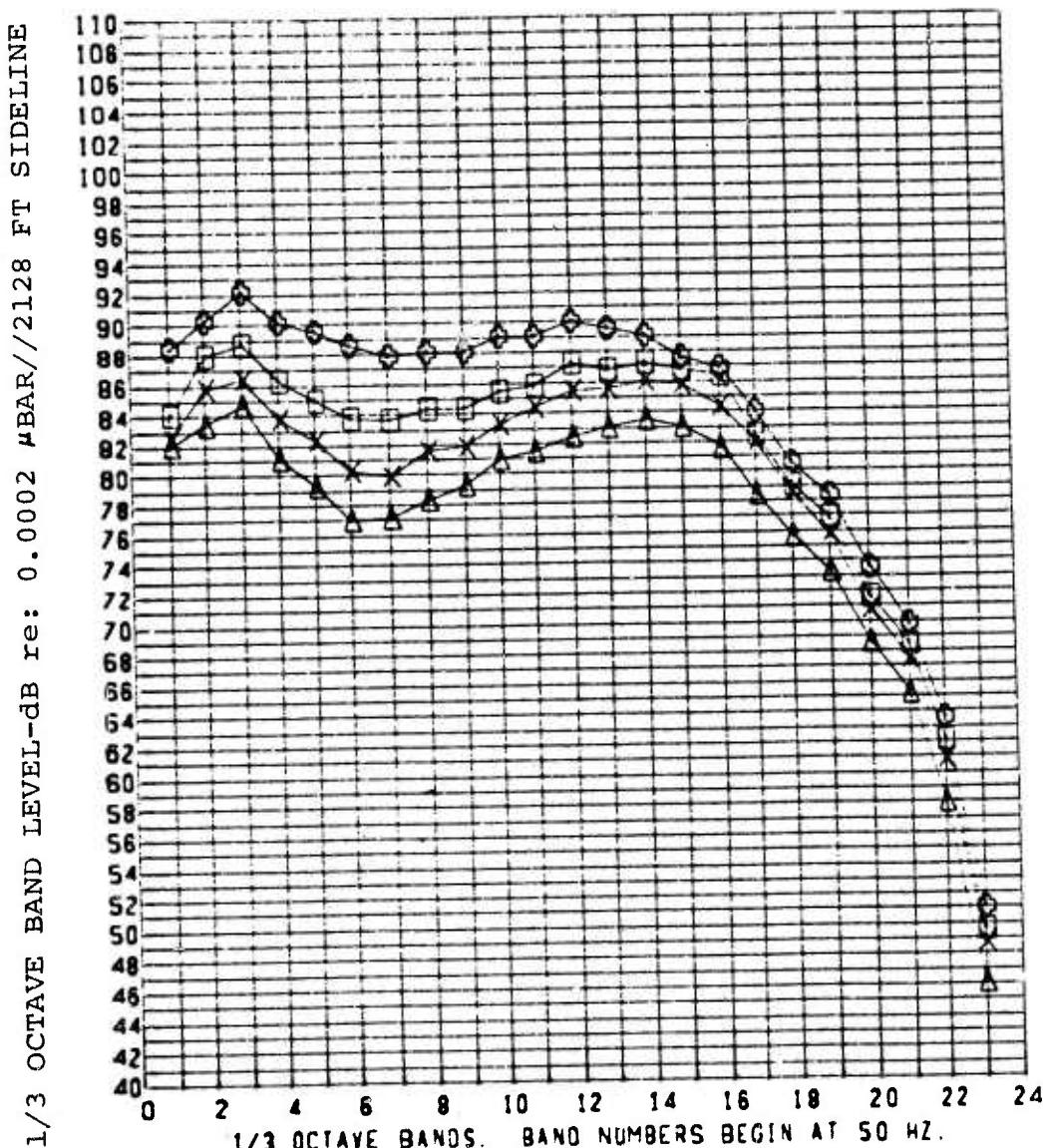


RUN 215
 $T_r = 1150^{\circ} F$ $A_s = 6.05 \text{ ft}^2$

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 215

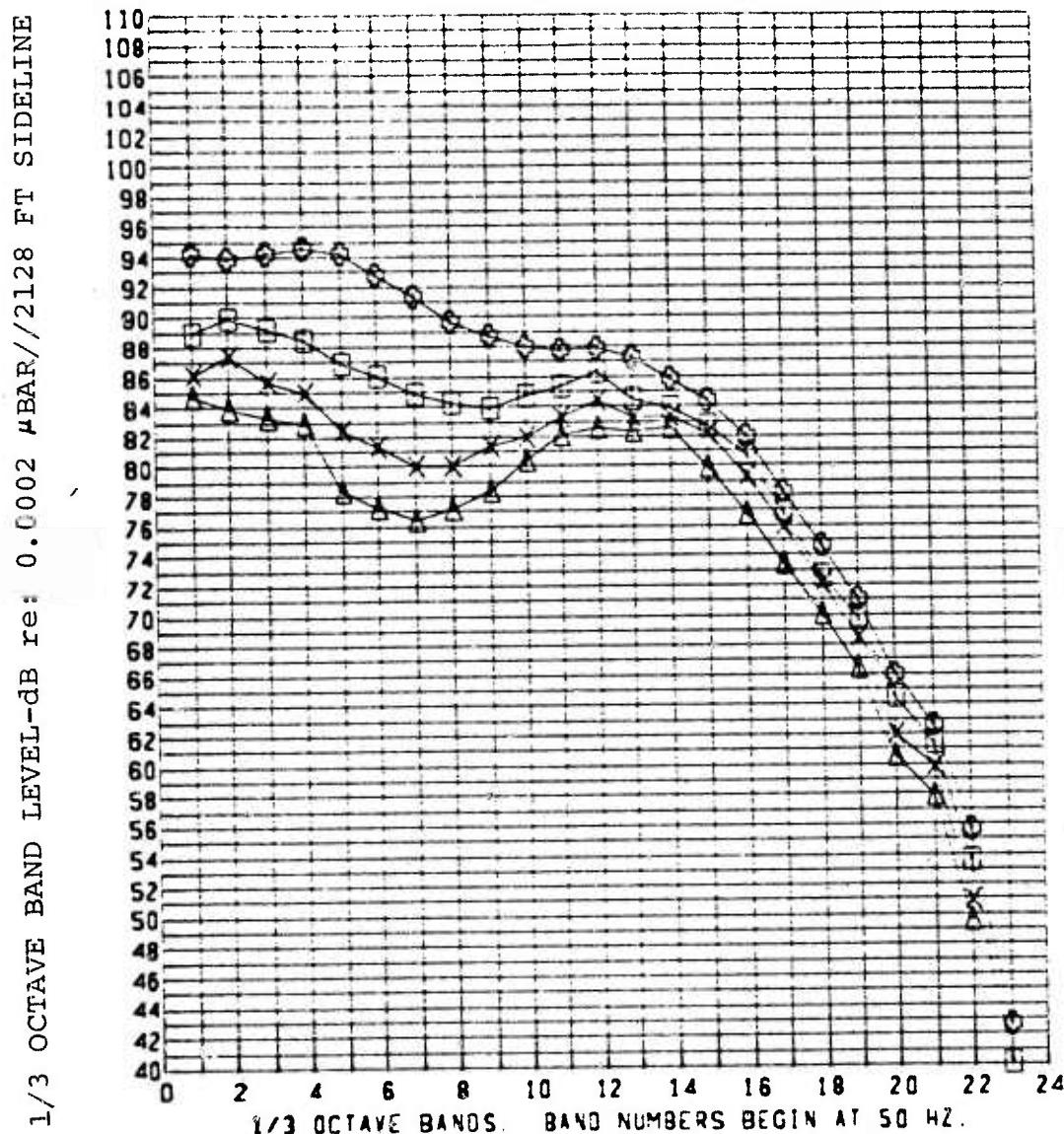
PR = Δ 2.0, \times 2.5, \square 3.0, \pm 4.0,

NOZZLE: 37T-4.5AR-RA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110° re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 215

PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 4.0

NOZZLE: 37T-4.5AR-RA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°
re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 37T-4.5AR-RA-ET/RC

FACILITY: WALL ISOLATION FACILITY

DATE: January 21, 1973

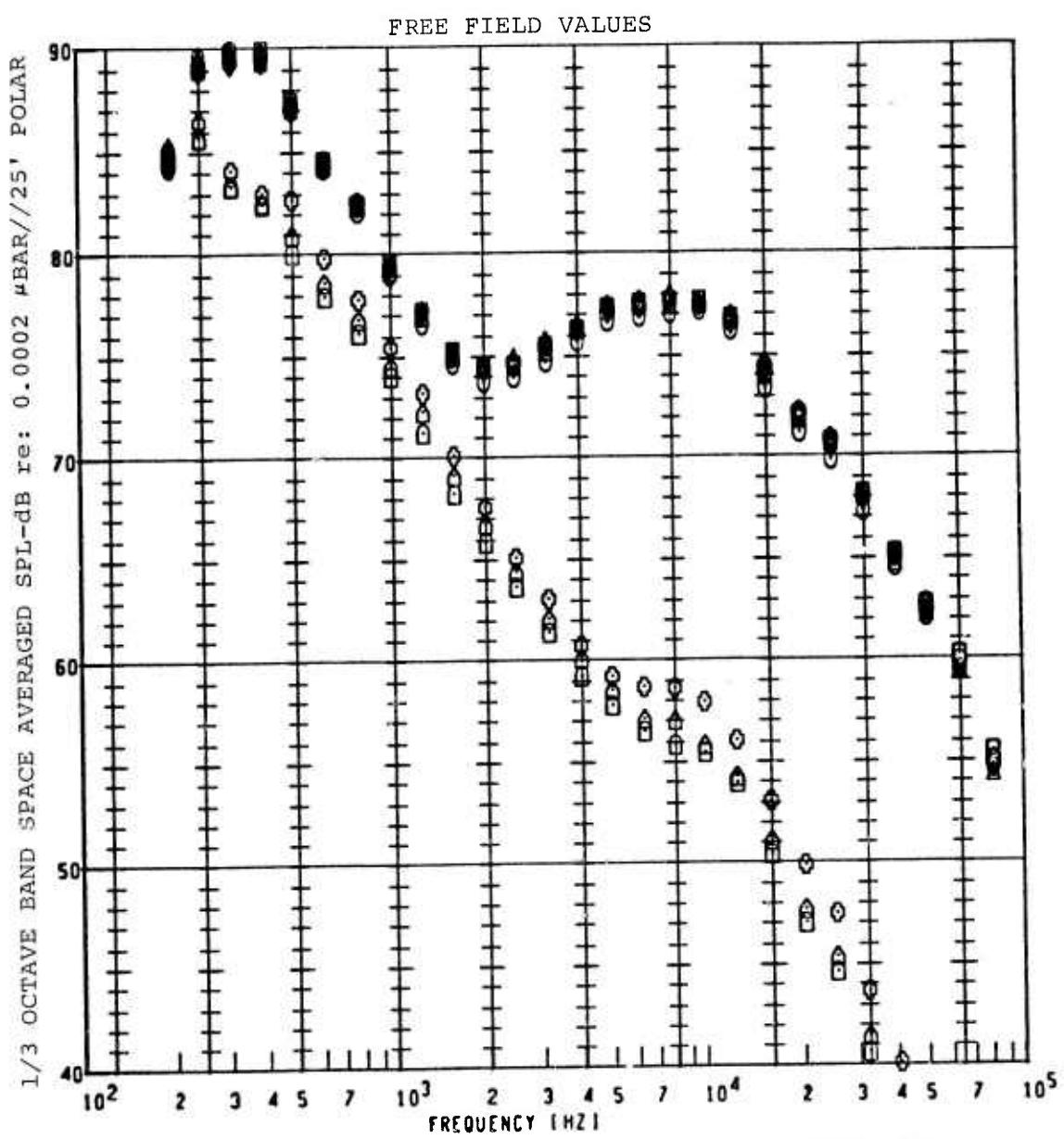
P_{AMB} = 30.06 in Hg **T_{AMB}** = 41°F **R.H.** = 85%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

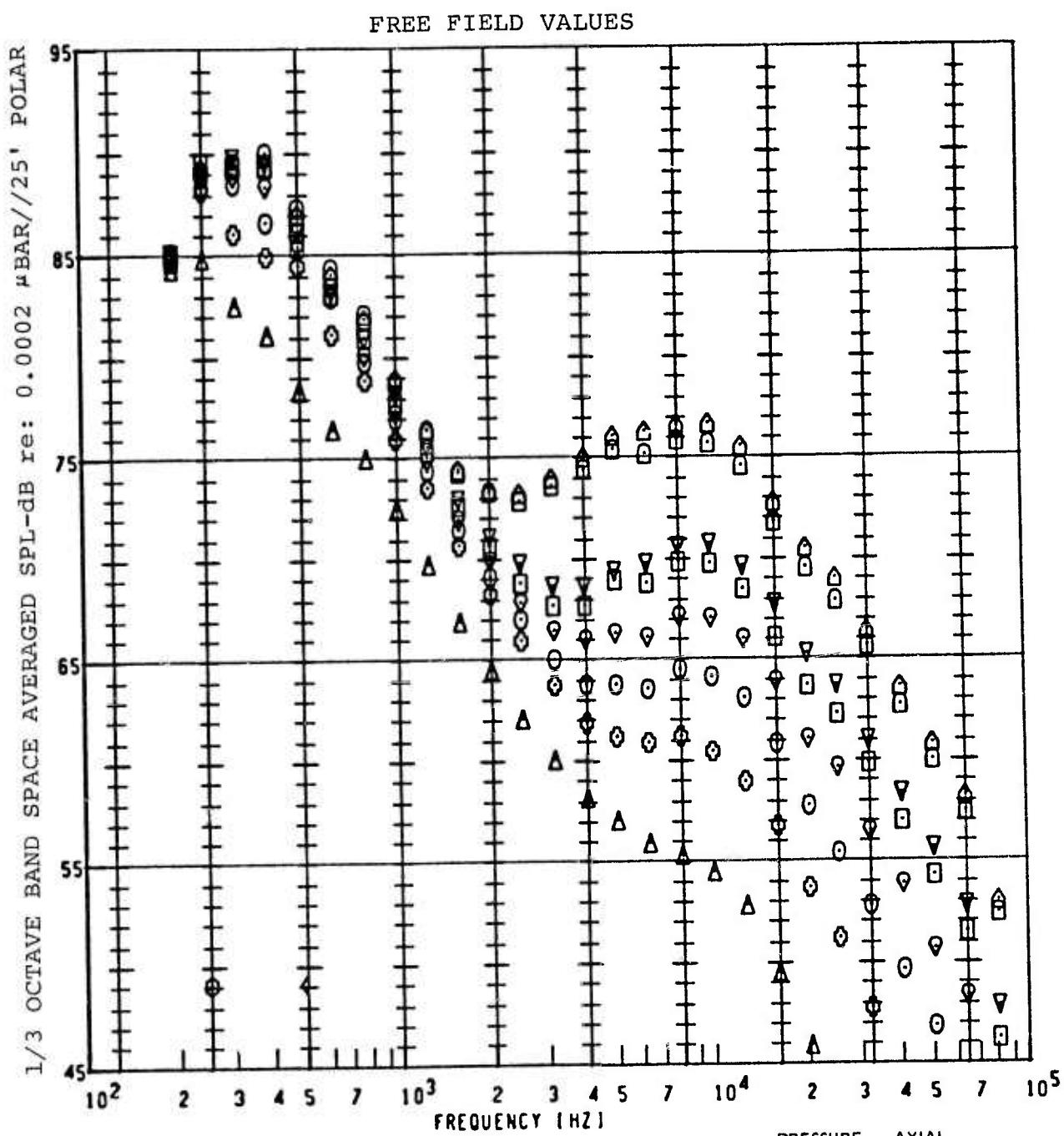
SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>AXIAL LOCATION</u>	<u>IRIS DIA.</u>	<u>REMARKS</u>	<u>REF.</u>
168	0.0 x/D	11.0 in.		
169	0.25	11.0		
170	0.50	11.5		
171	0.75	11.5		
172	1.00	12.0		
173	1.25	12.0		
174	1.50	12.0		
175	1.75	12.5		
176	2.00	12.5		
177	2.25	13.0		
178	2.50	13.0		
179	2.75	13.5		
180	3.0	13.5		
181	3.5	14.0		
182	4.0	14.5		
183	5.0	15.5		
184	6.0	16.5		
185	8.0	18.0		
186	10.0	20.0		
187	12.0	22.0		
188	14.0	24.0		
189	16.0	25.5		

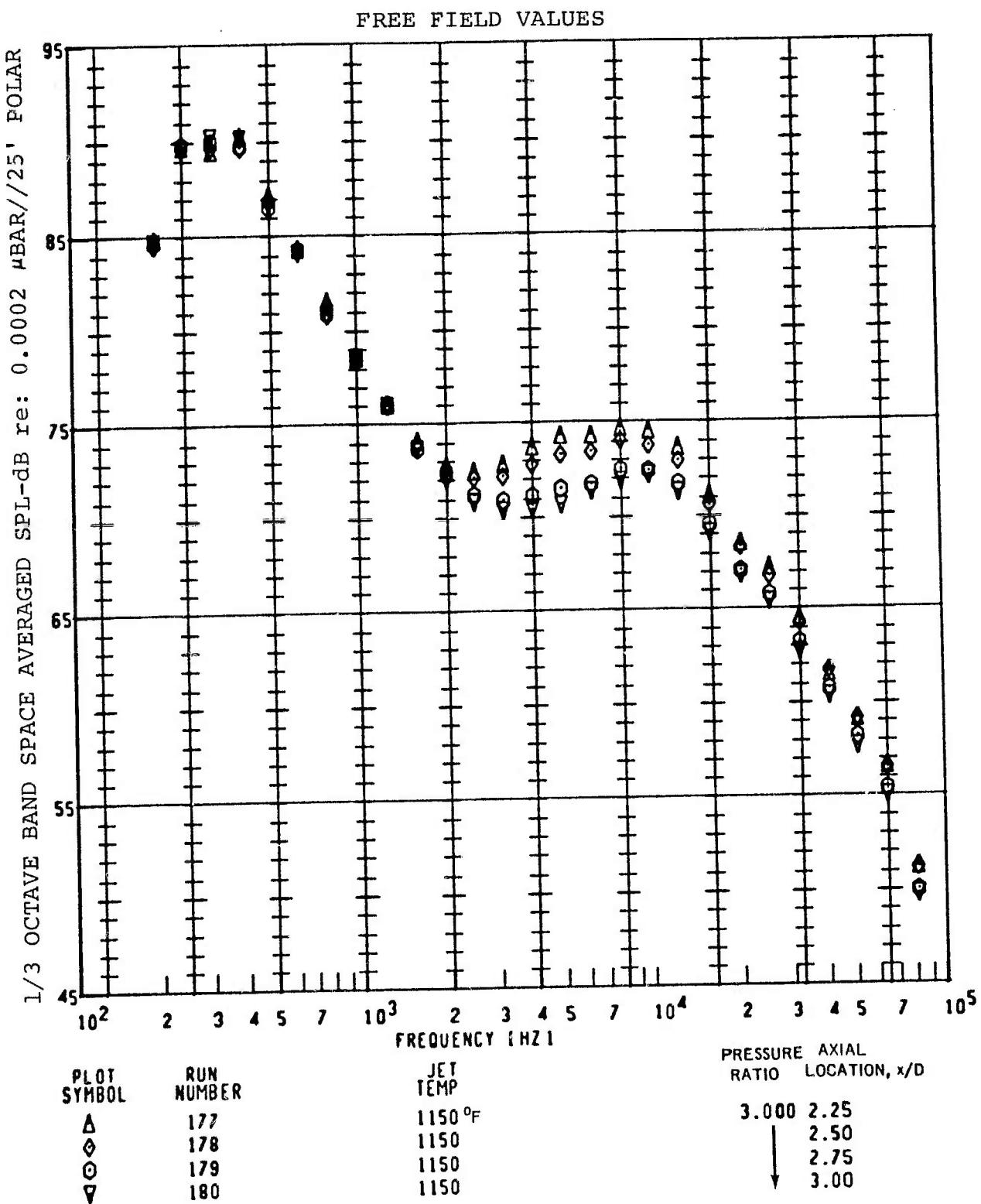
MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

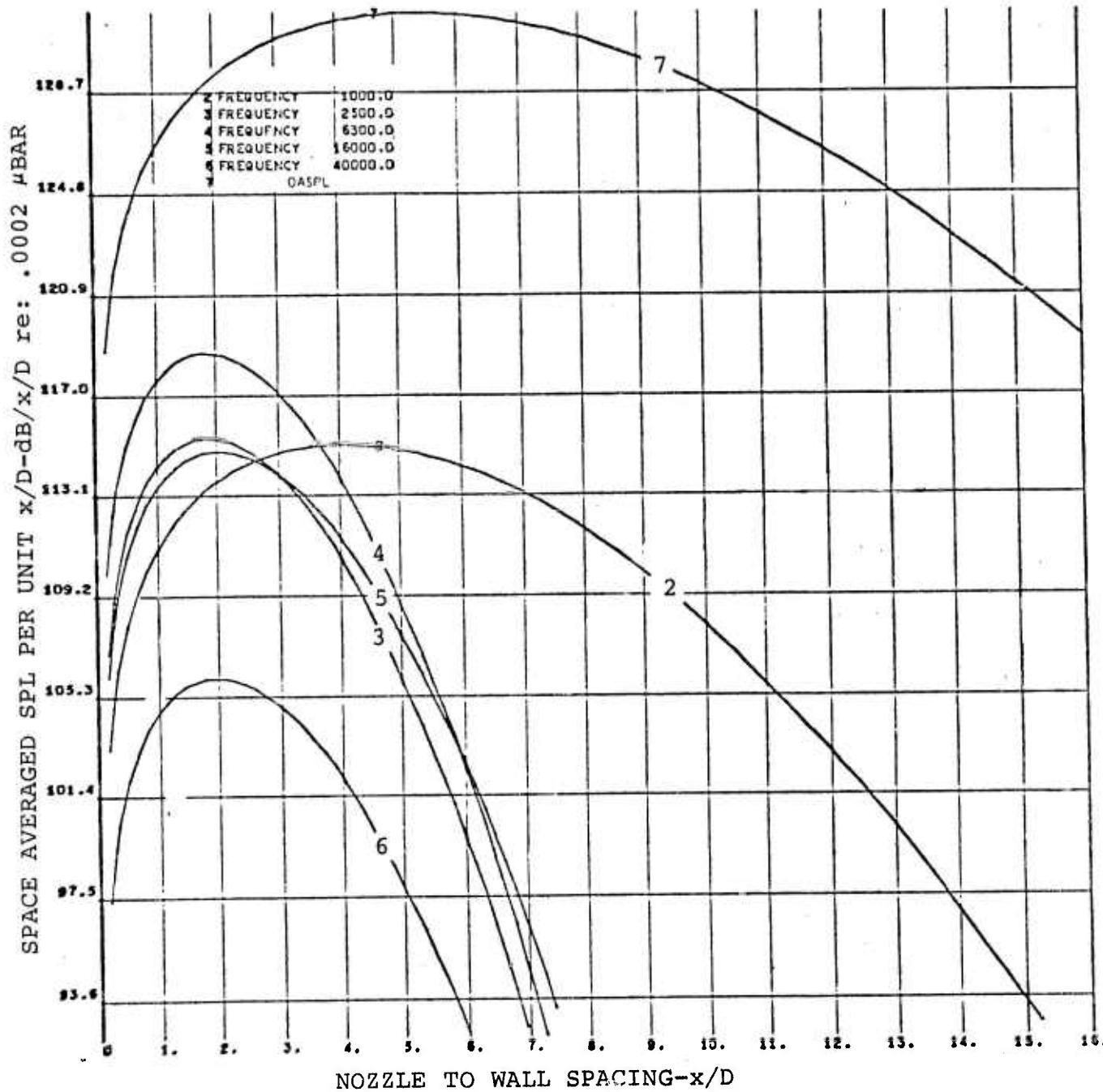


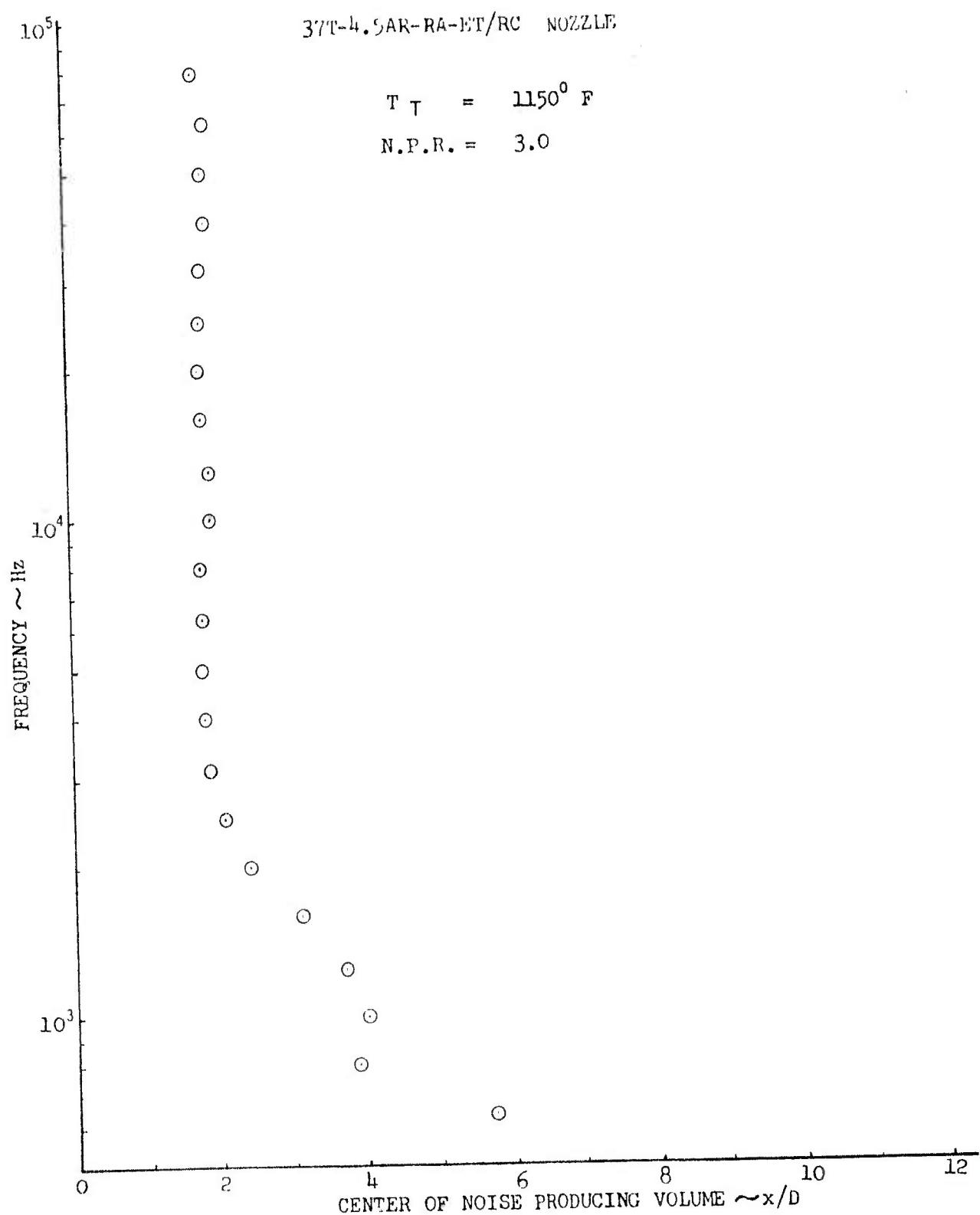
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	168	1150°F	3.000	0.00
◊	169	1150		0.25
○	170	1150		0.50
▽	171	1150		0.75
□	172	1150		1.00
○	173	1150		1.25
○	174	1150		1.50
○	186	1150		10.00
○	187	1150		12.00
○	188	1150		14.00

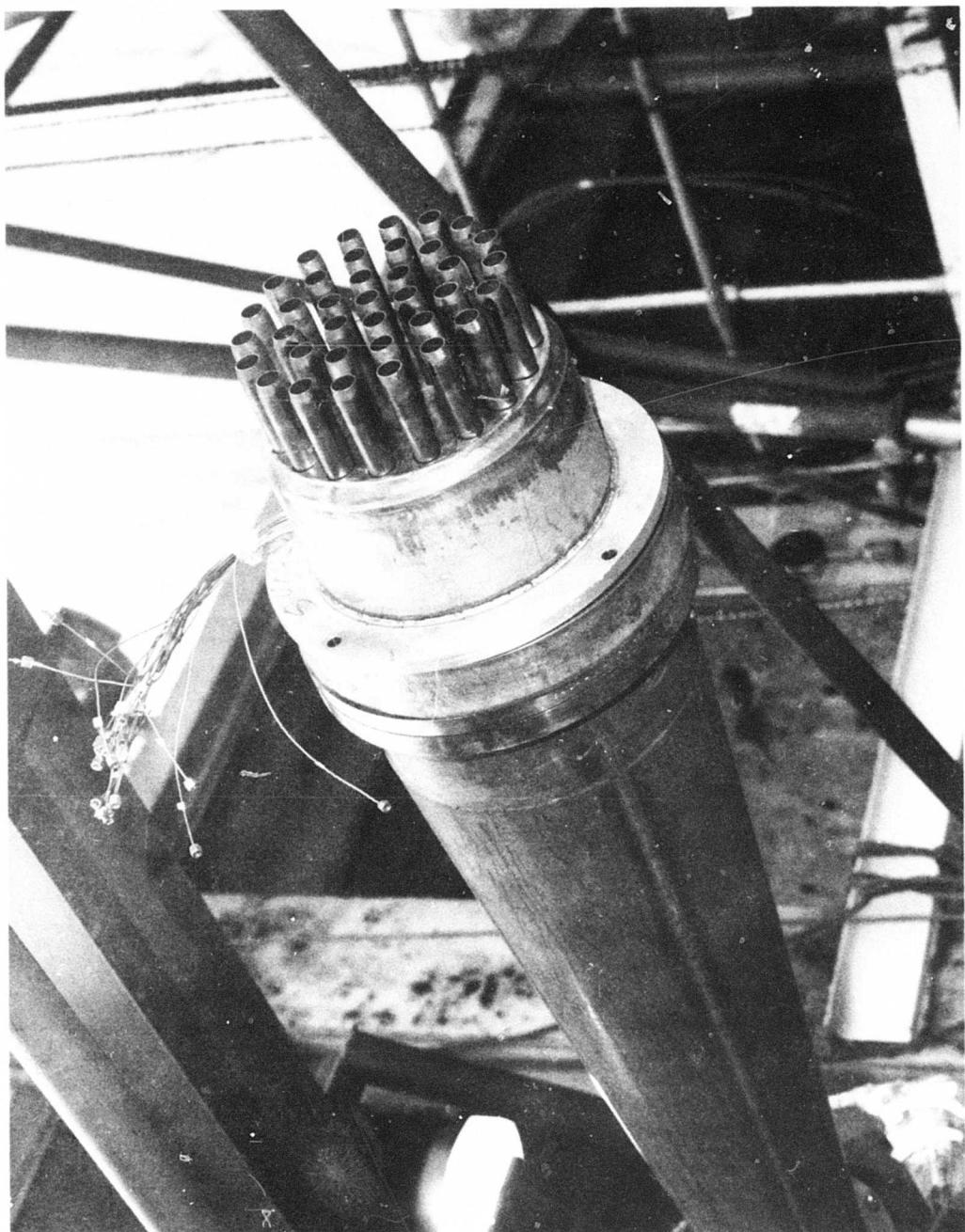


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	AXIAL LOCATION, x/D
△	189	1150°F	3.0	16.00
▲	181	1150	3.0	3.50
▼	182	1150	3.0	4.00
◆	183	1150	3.0	5.00
□	184	1150	3.0	6.00
○	185	1150	3.0	8.00
◇	175	1150	3.0	1.75
◆	176	1150	3.0	2.00

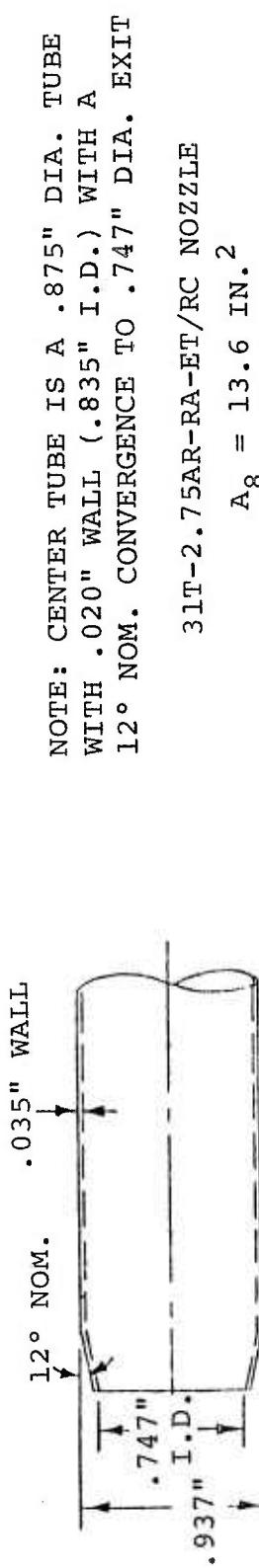






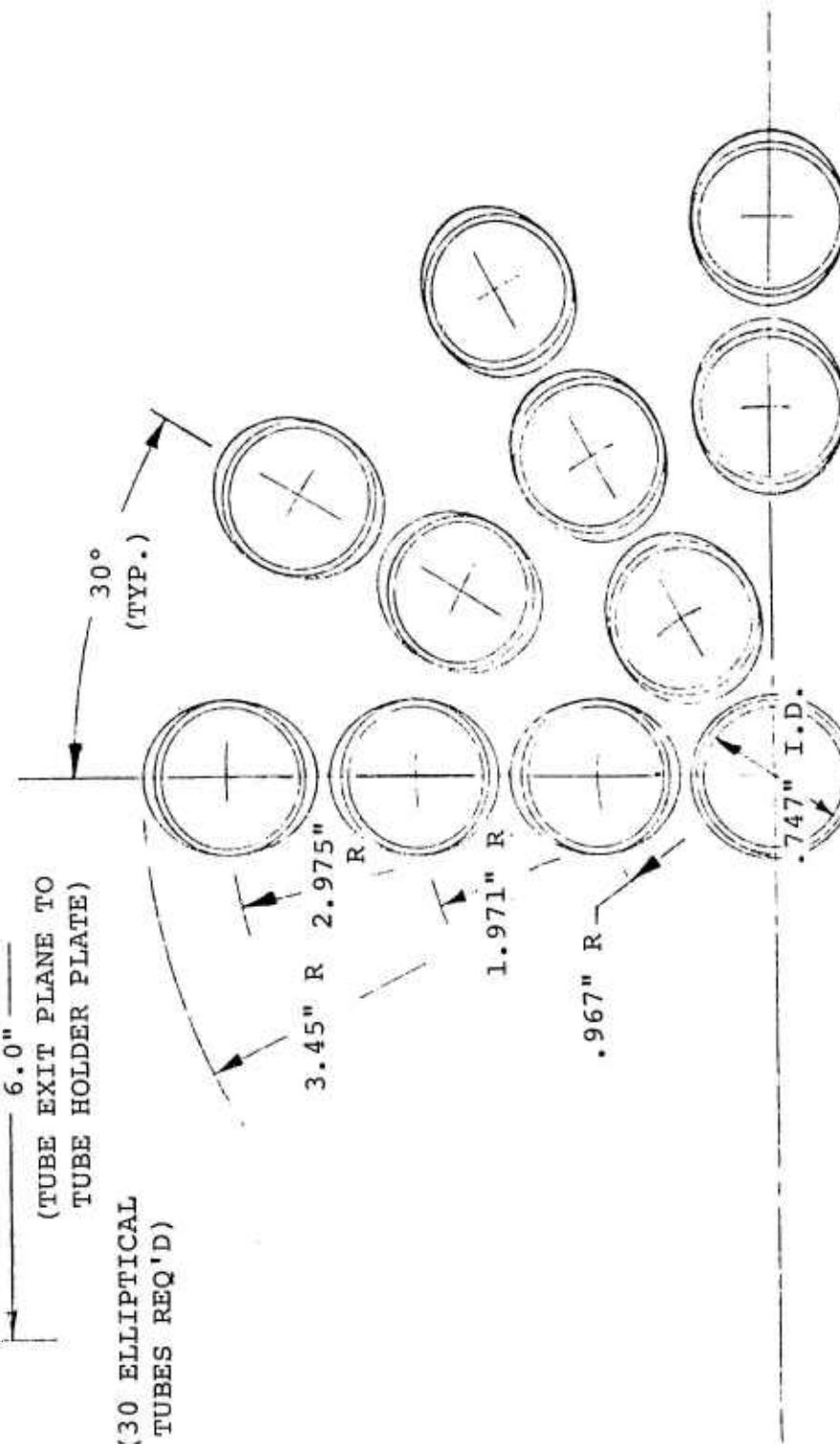


31T-2.75AR-RA-ET/RC NOZZLE



NOTE: CENTER TUBE IS A .875" DIA. TUBE
WITH .020" WALL (.835" I.D.) WITH A
12° NOM. CONVERGENCE TO .747" DIA. EXIT

31T-2.75AR-RA-ET/RC NOZZLE
 $A_8 = 13.6 \text{ IN.}^2$



31 TUBE - AREA RATIO 2.75 ELLIPTICAL TUBES RADIAL ARRAY

TEST CONDITIONS

NOZZLE: 31T-2.75AR-RA-ET/RC

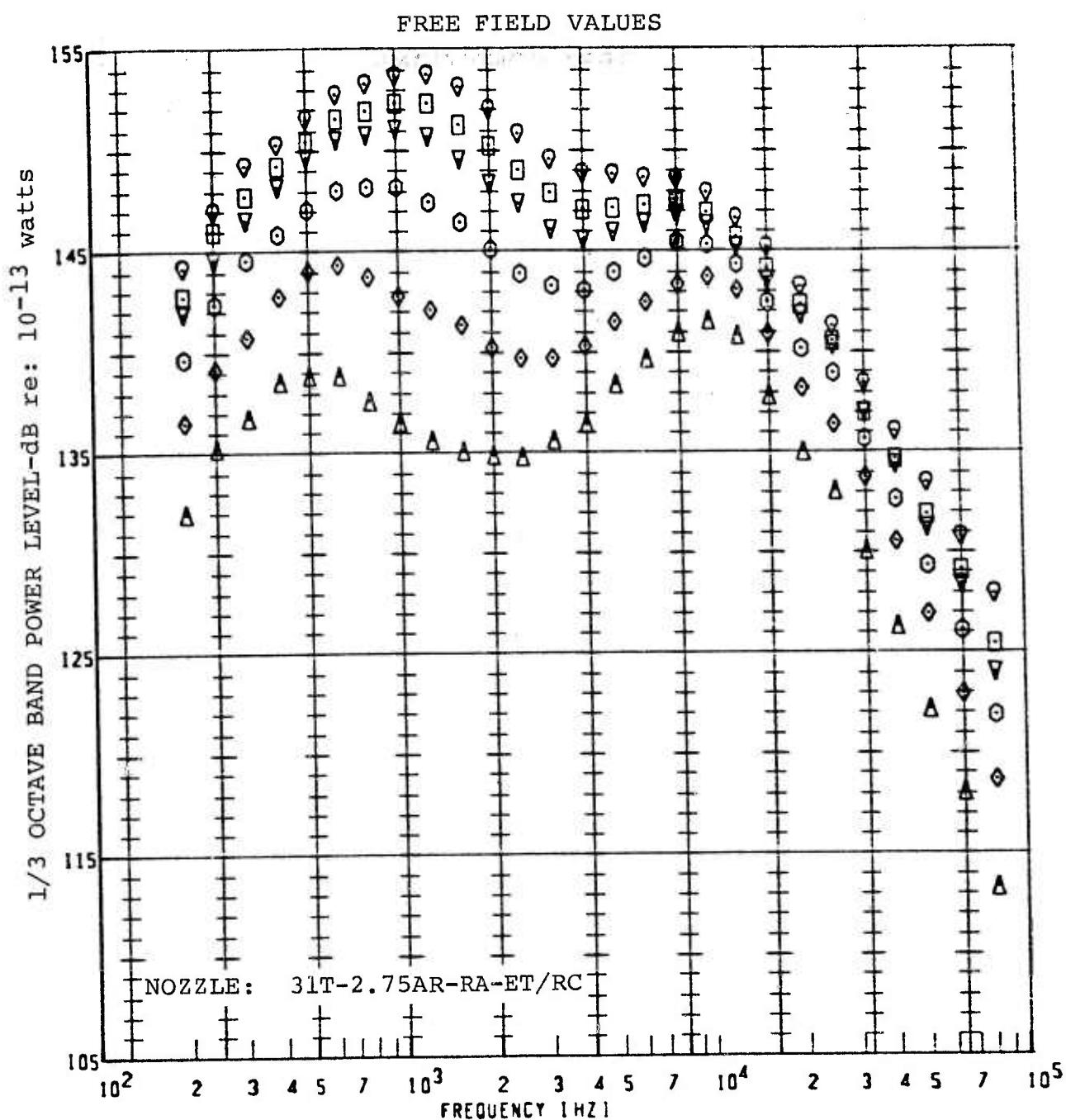
FACILITY: HNTF

DATE: 6-18-73 **T_{AMB}** = 58 °F **R.H.** = 66%

SCALE MODEL A₈ = 13.6 in.²

RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
82	2.0	1150 °F	1875 fps		
"	2.5	"	2126		
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

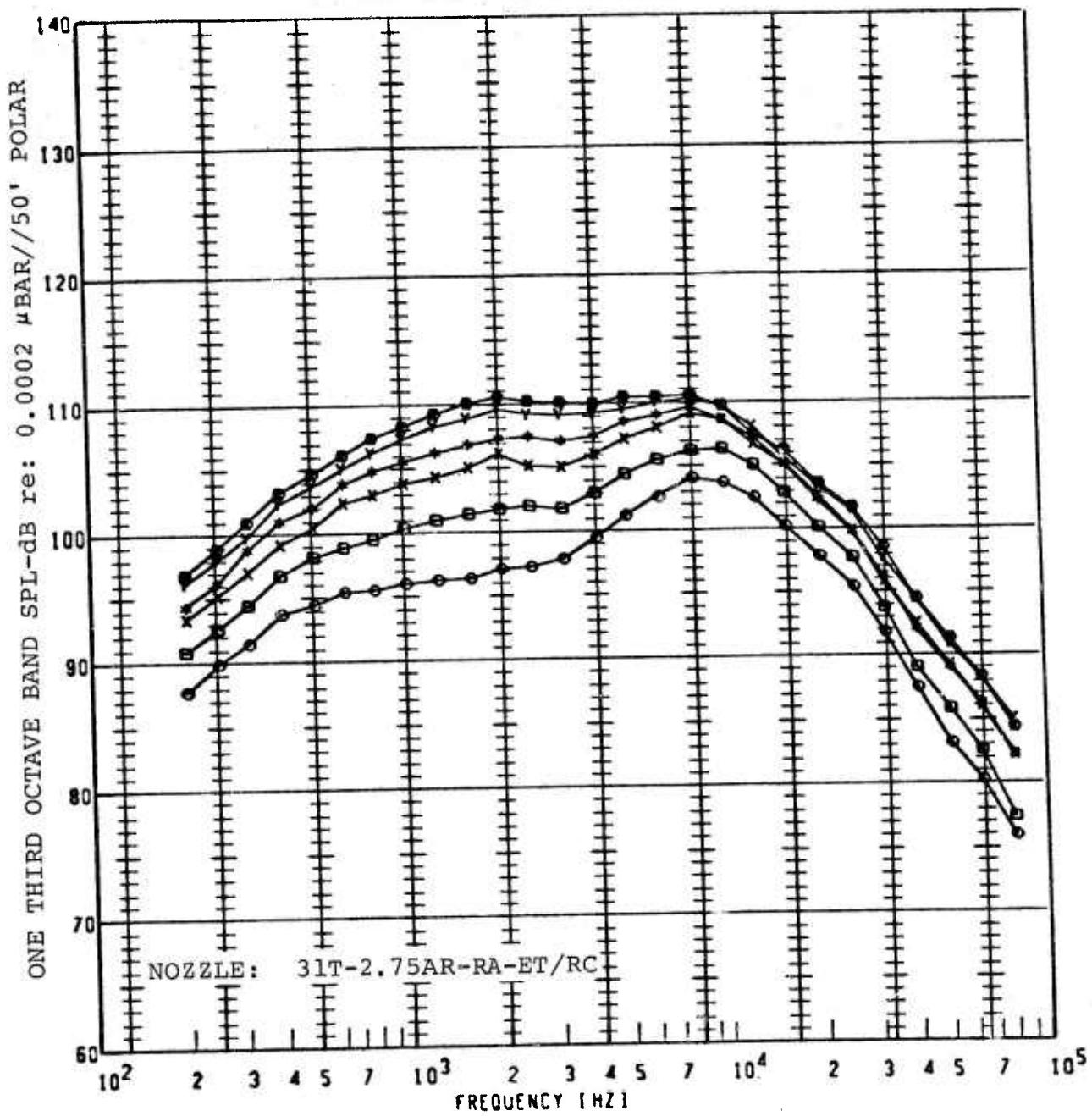
MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
Δ	82	2.00	1150°F
◊	82	2.50	1150
○	82	3.00	1150
▽	82	3.40	1150
□	82	3.70	1150
✖	82	4.00	1150

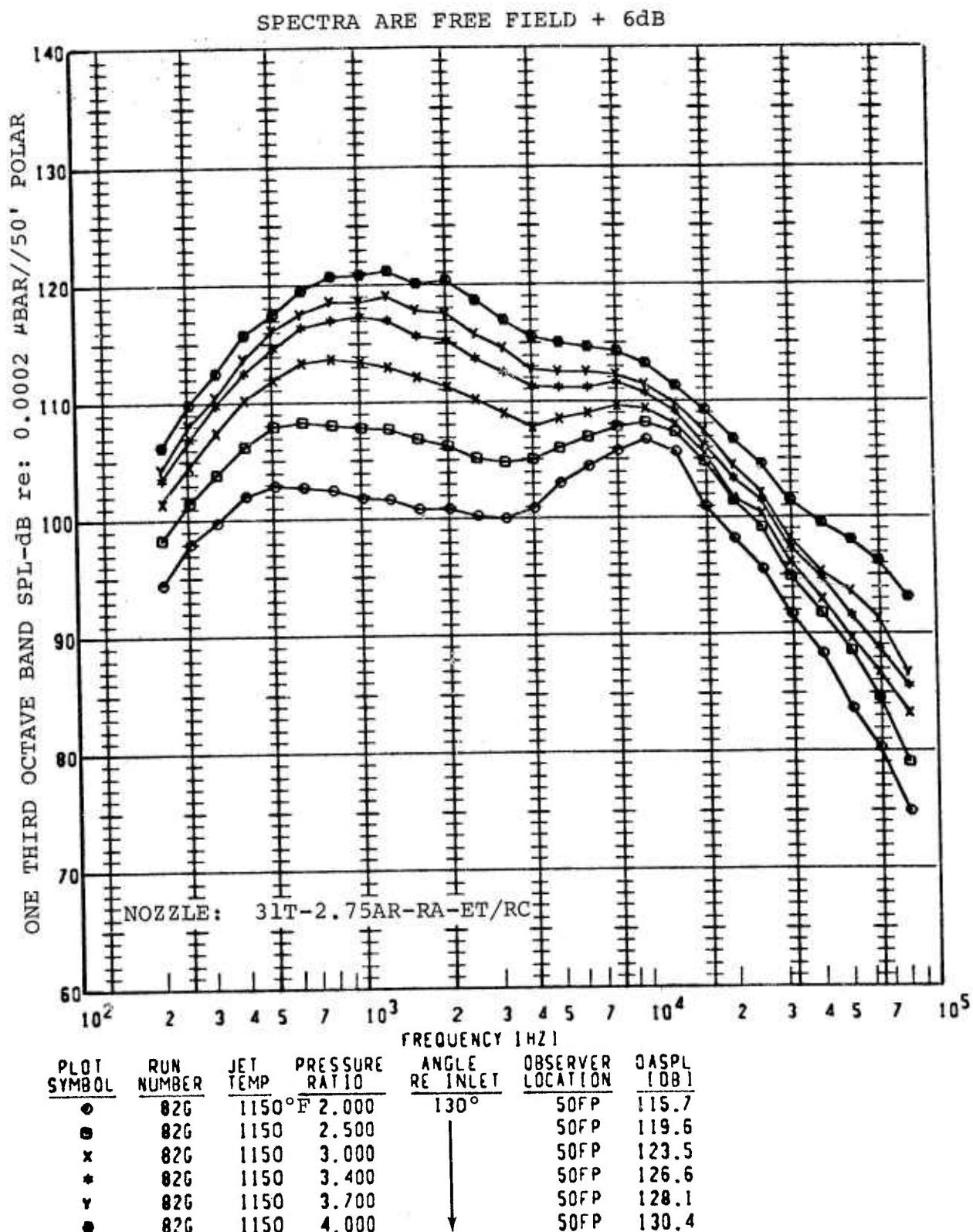
JET NOISE POWER SPECTRA

SPECTRA ARE FREE FIELD + 6dB

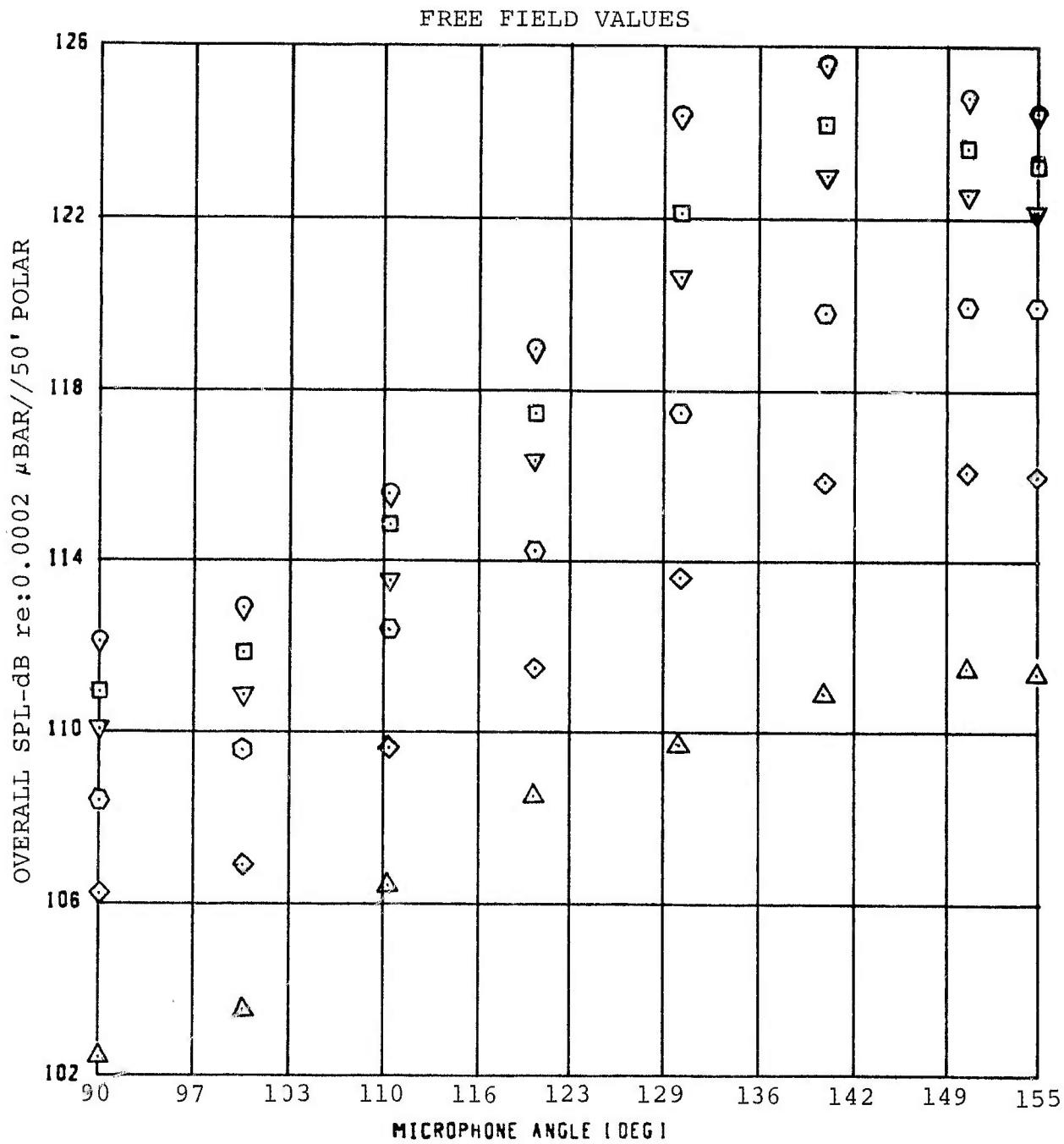


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [DB]
•	826	1150°F	2.000	110°	SOFP	112.4
●	826	1150	2.500		SOFP	115.5
x	826	1150	3.000		SOFP	118.3
*	826	1150	3.400		SOFP	119.4
Y	826	1150	3.700		SOFP	120.8
●	826	1150	4.000		SOFP	121.6

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

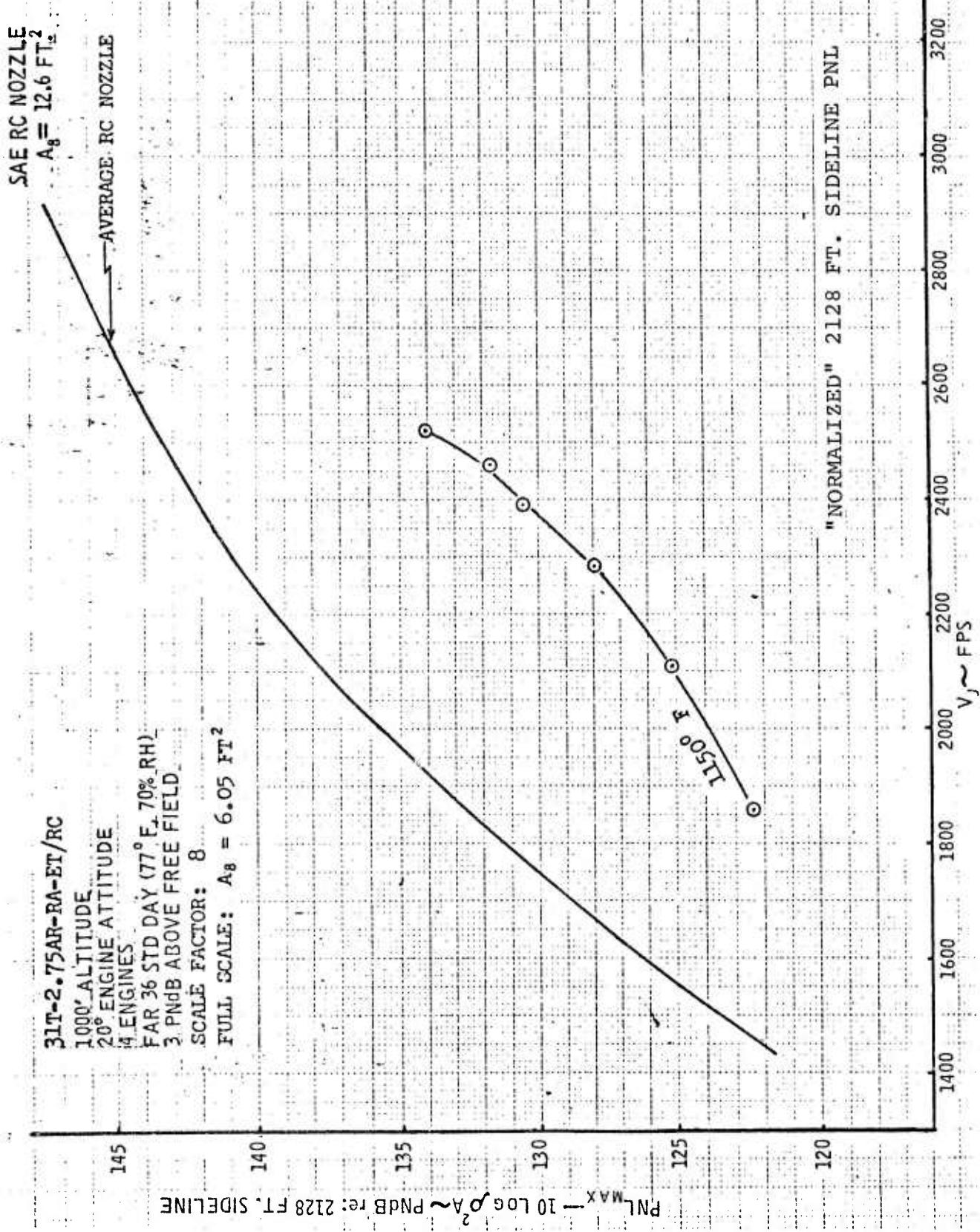


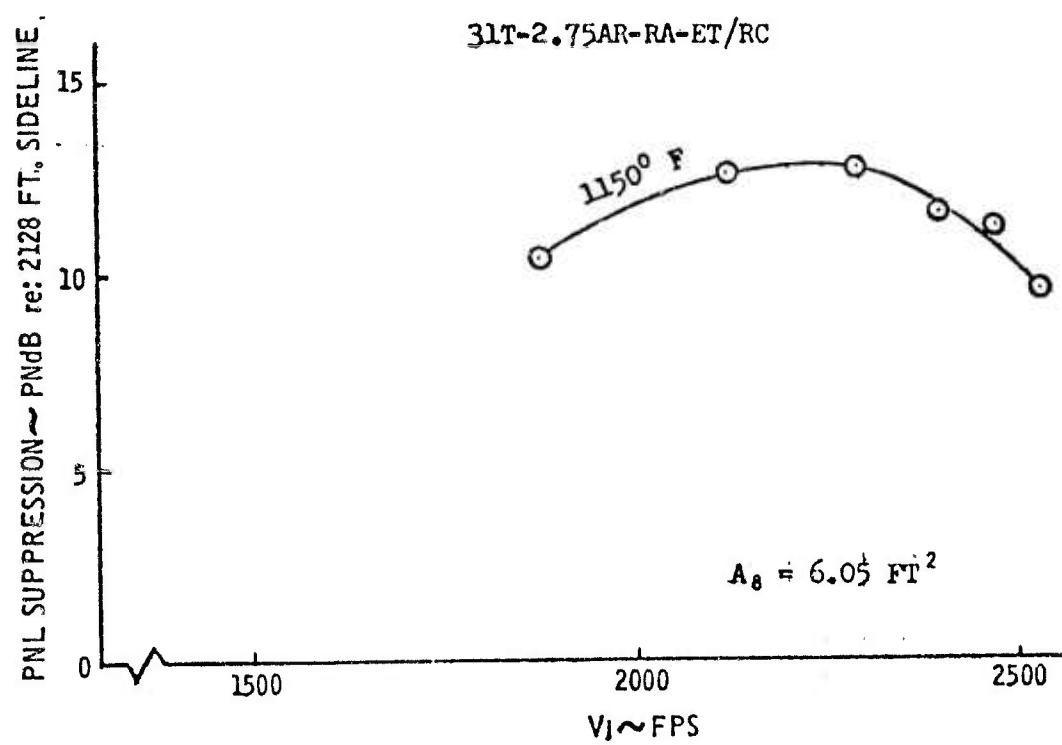
MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



NOZZLE: 31T-2.75AR-RA-ET/RC

OASPL BEAM PATTERNS



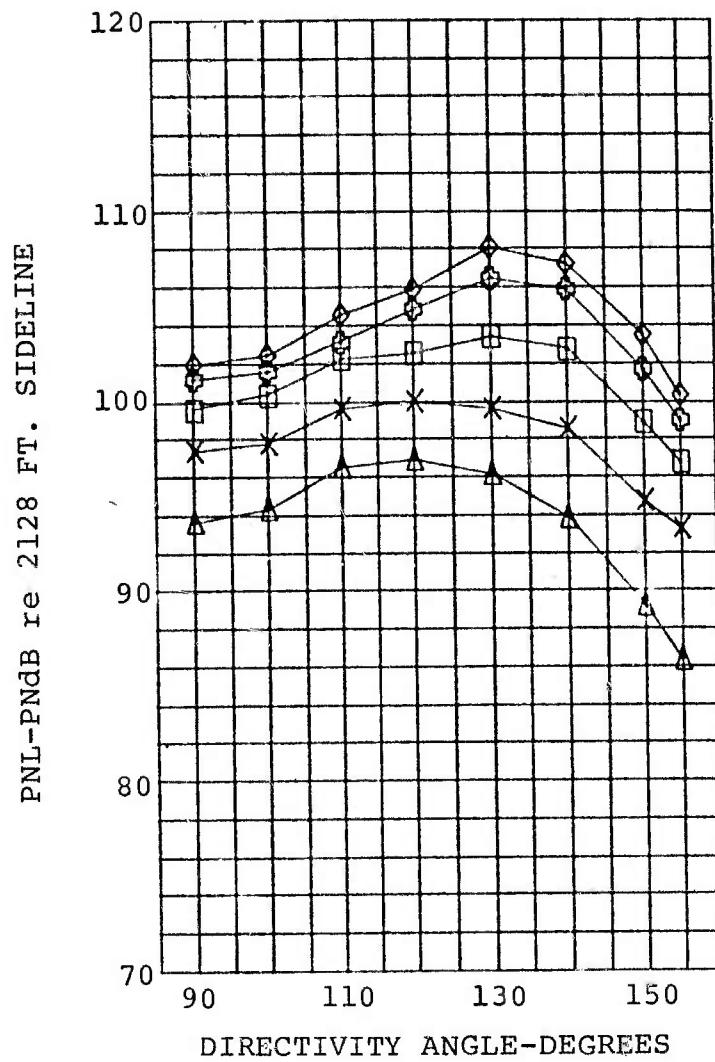


PEAK PNL SUPPRESSION VALUES

NOZZLE: 31T-2.75AR-RA-ET/RC

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = TEMP = 77 DEG R.H. = 70 PER CENT

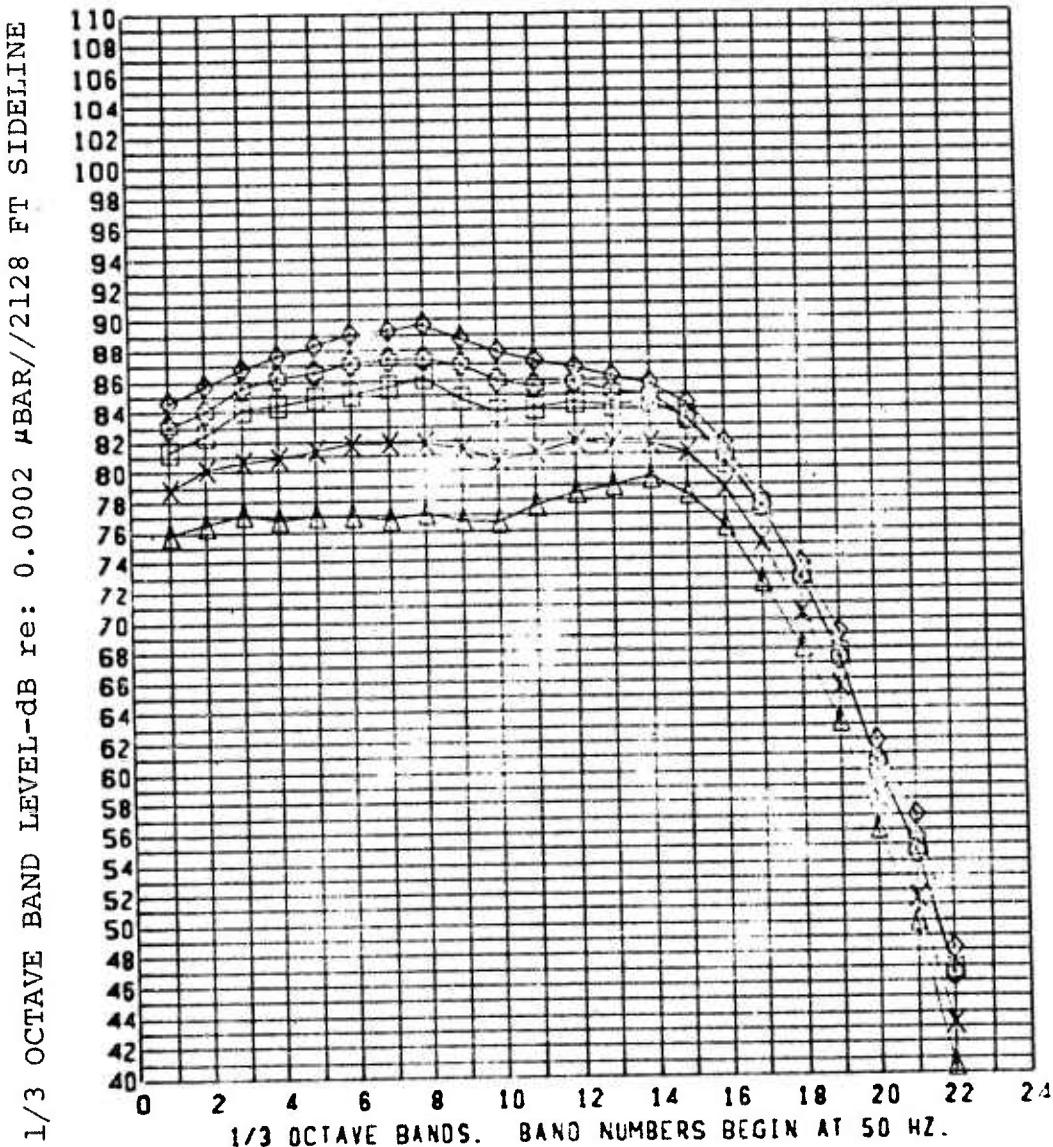


TT = 1150°F A8 = 6.05 FT² RUN: 82
PR = Δ 2.0, X 2.5, □ 3.0, ♦ 3.4, ◇ 3.7

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 82

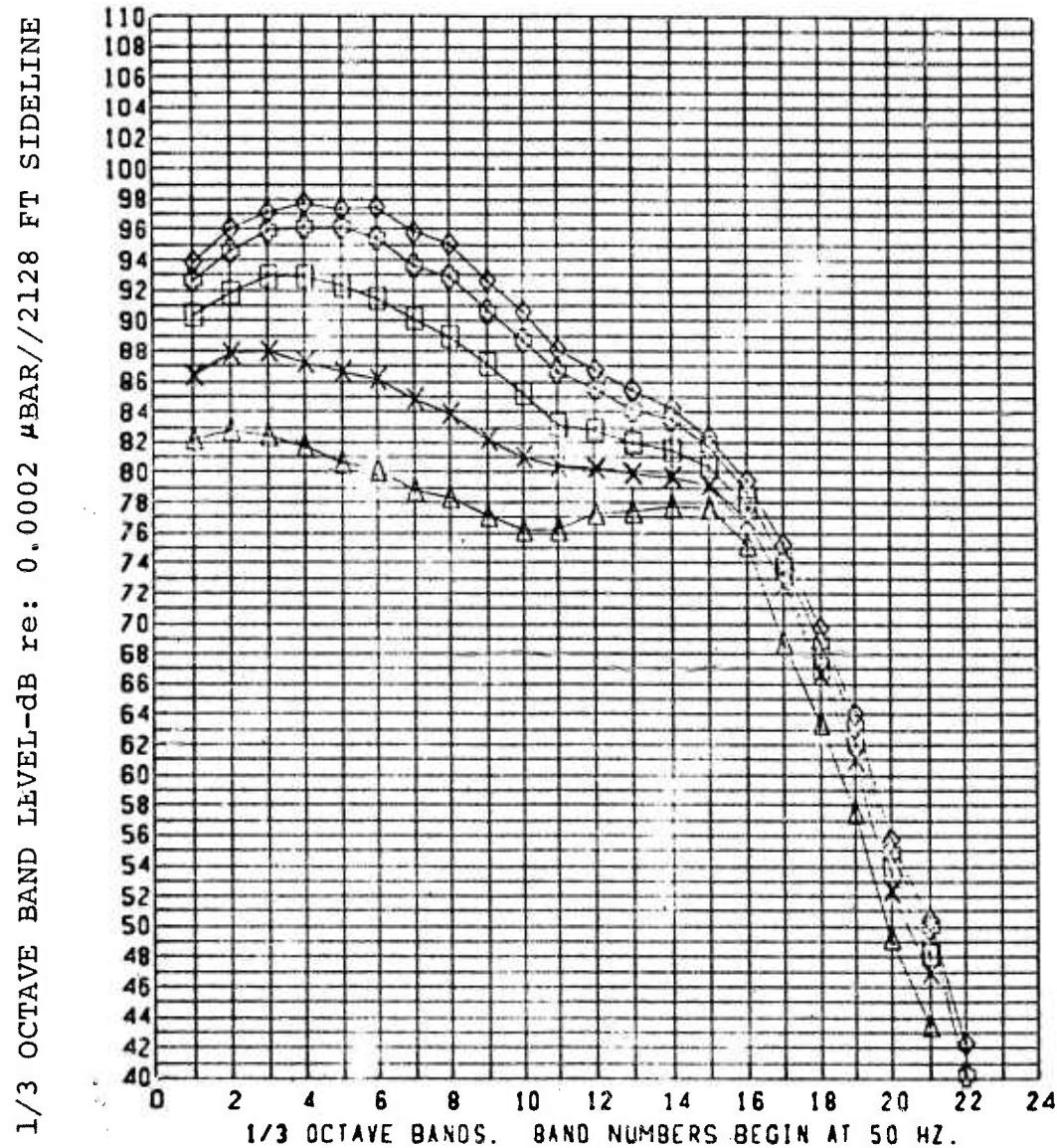
PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.4, \diamond 3.7

NOZZLE: 3LT-2.75AR-RA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°

re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 82

PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 3.4, \diamond 3.7

NOZZLE: 31T-2.75AR-RA-ET/RC

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°
re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 31T-2.75AR-RA-ET/RC
with 2.6AR Ejector

FACILITY: HNTF

DATE: 9-12-73

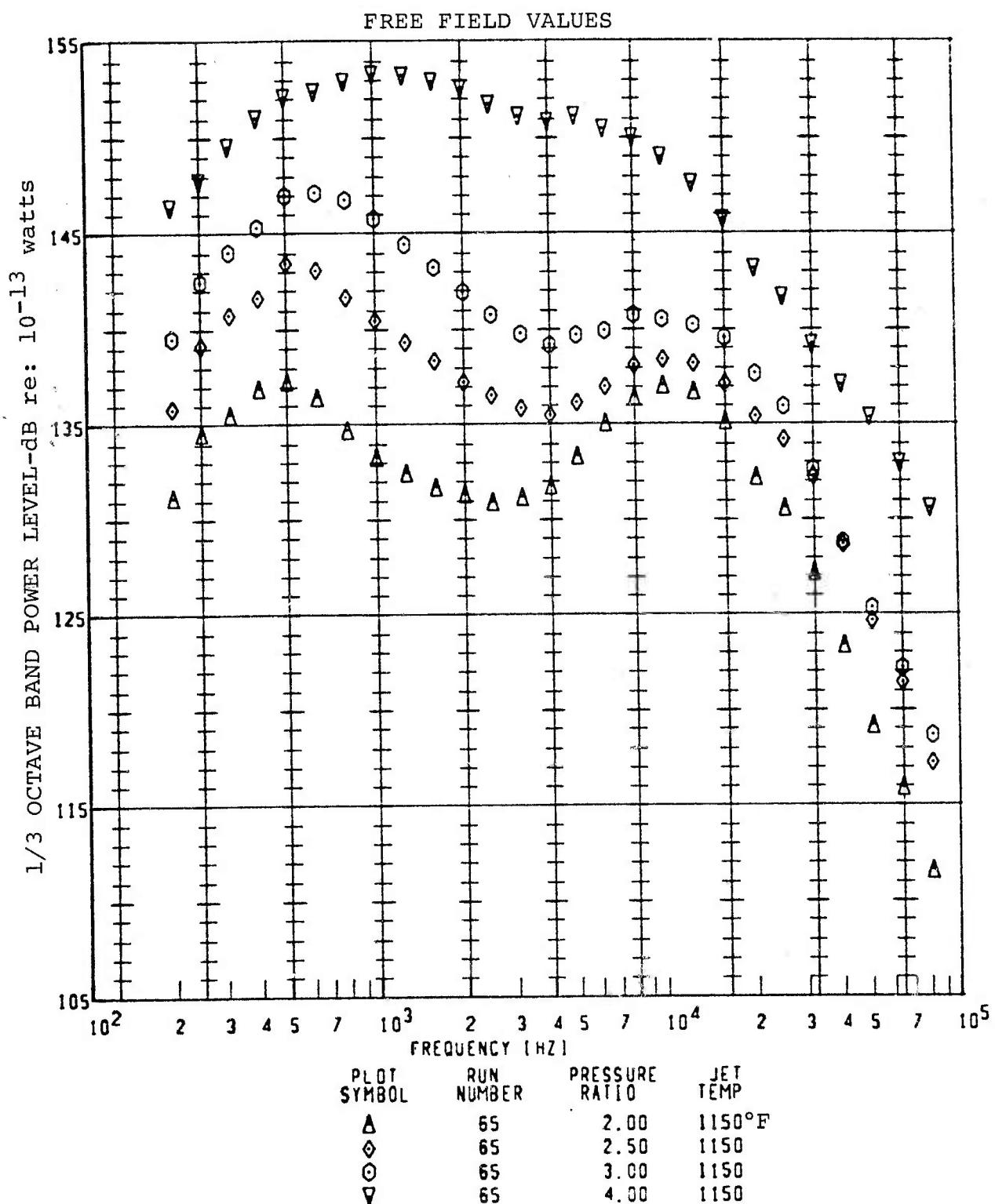
T_{AMB} = 66°F

R.H. = 72%

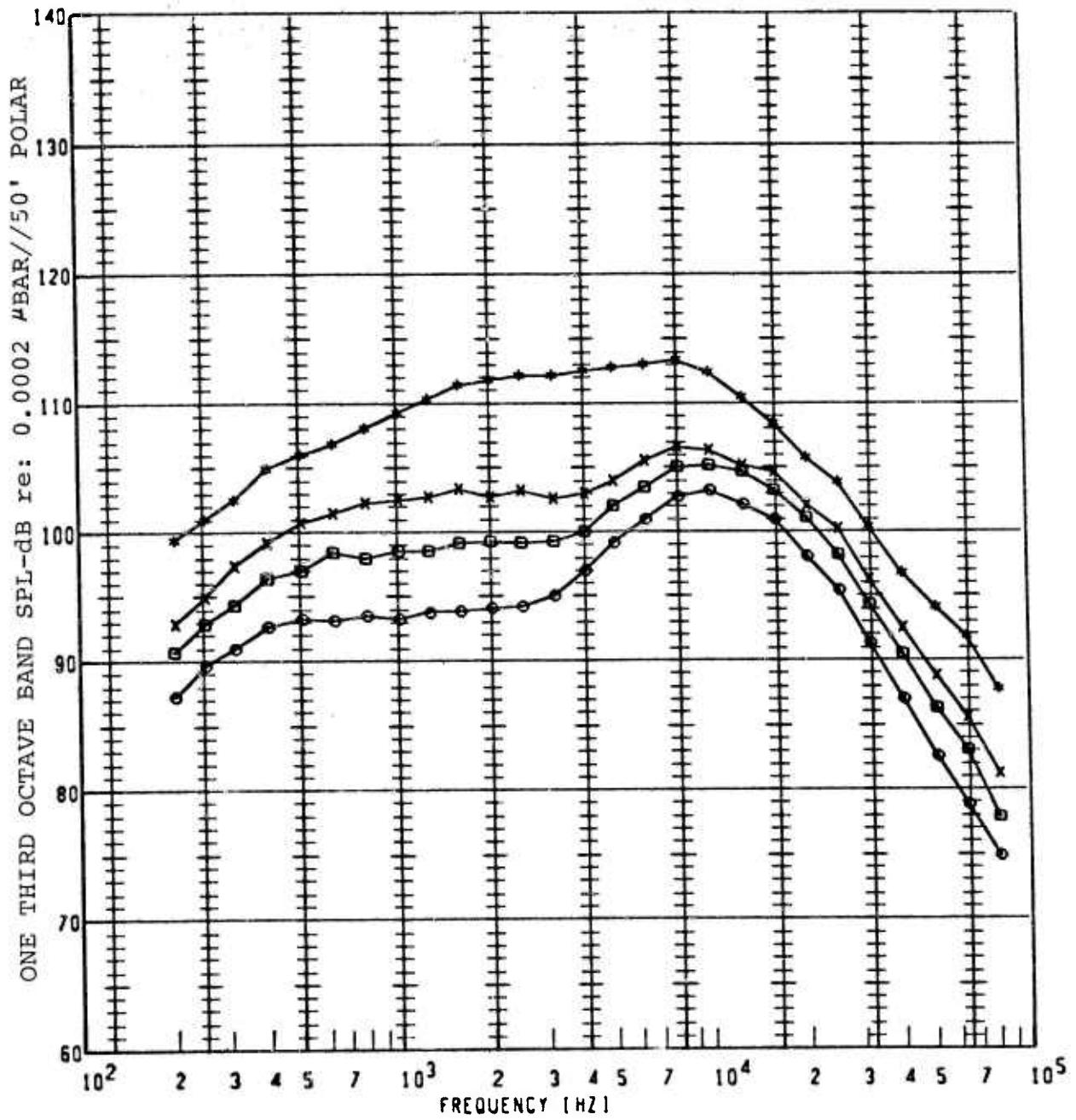
SCALE MODEL A₈ = 13.6 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
65	2.0	1150°F	1875 fps		
"	2.5	"	2126		
"	3.0	"	2303		
"	4.0	"	2544		

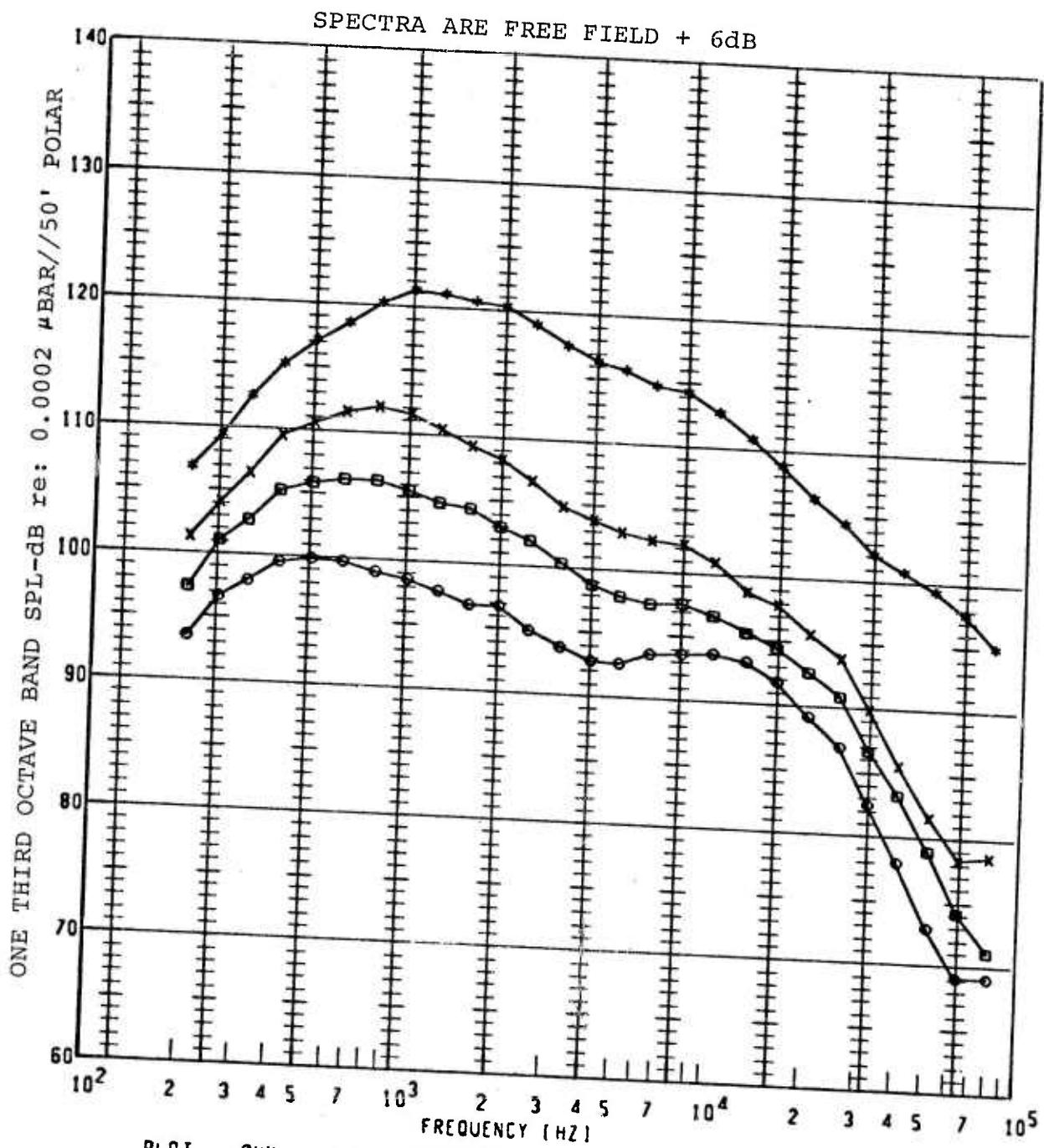
MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



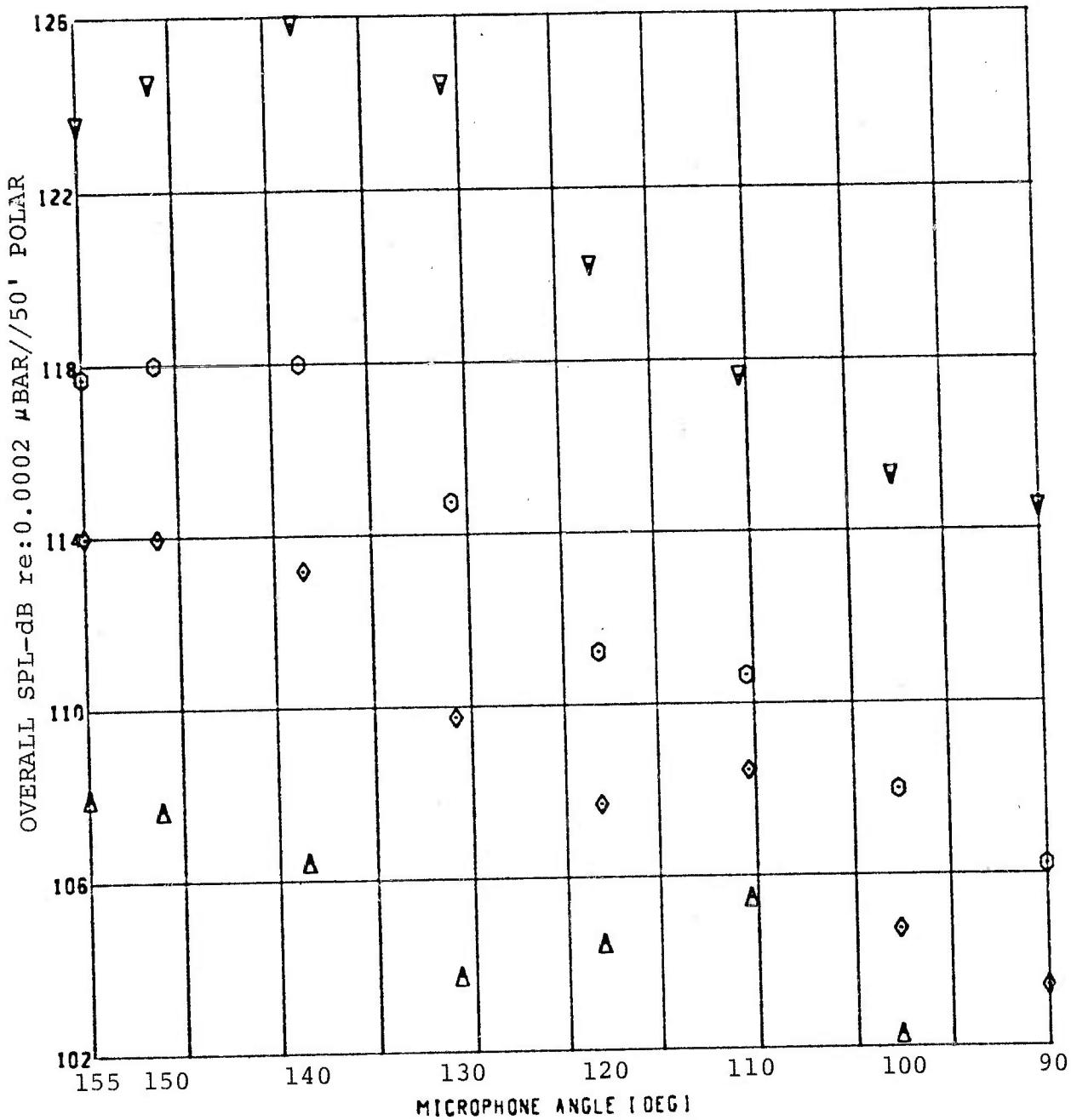
SPECTRA ARE FREE FIELD + 6dB



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [dB]
●	65G	1150° F	2.000	110°	50FP	111.2
○	65G	1150	2.500	↓	50FP	114.2
✖	65G	1150	3.000	↓	50FP	116.5
*	65G	1150	4.000	↓	50FP	123.5



FREE FIELD VALUES



SAE RC NOZZLE
 $A_8 = 12.6 \text{ FT}^2$

31T-2.75AR-RA-ET/RC WITH 2.6AR EJECTOR!

1000' ALTITUDE

20° ENGINE ATTITUDE

4 ENGINES

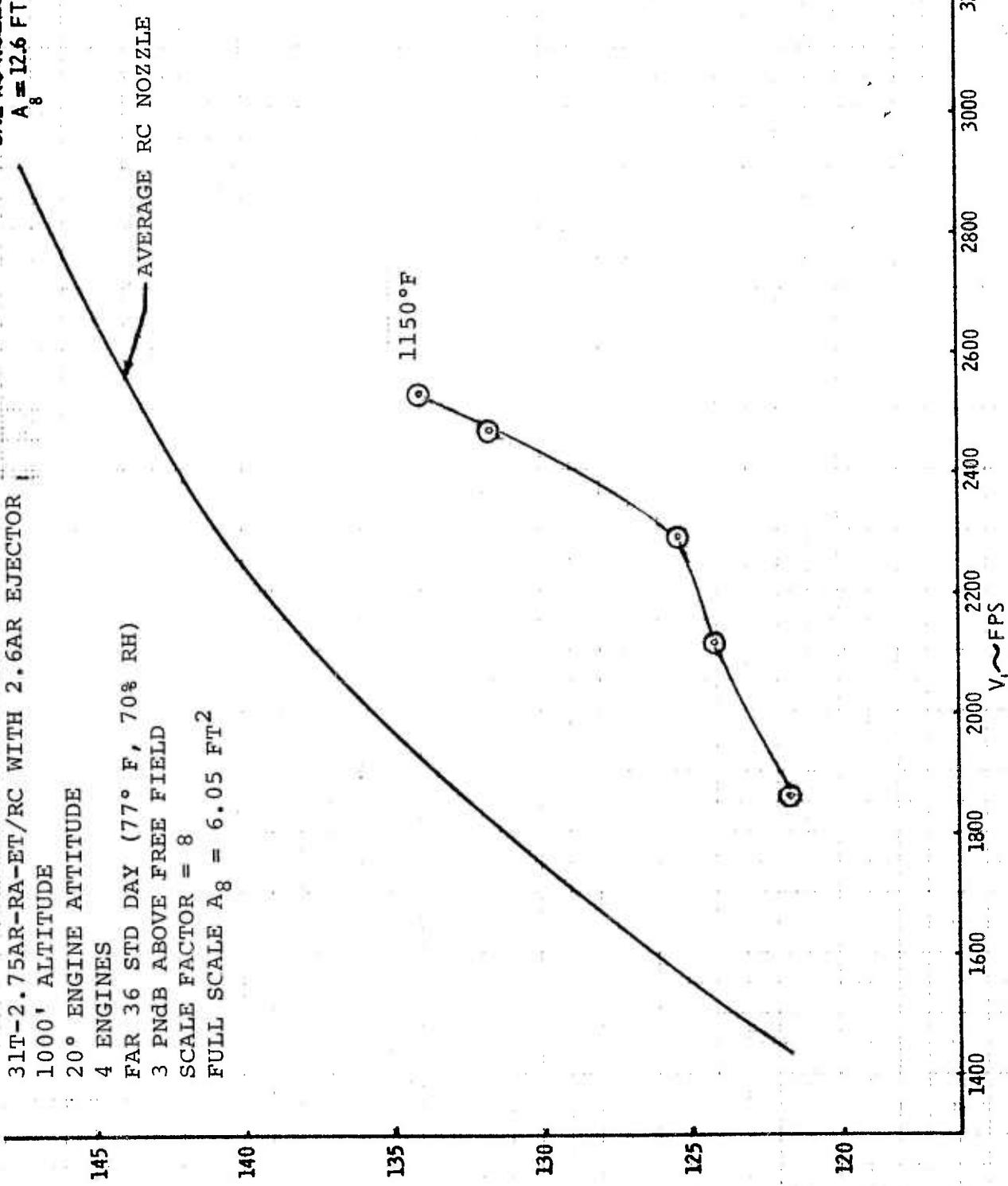
FAR 36 STD DAY (77° F, 70% RH)

3 PNDB ABOVE FREE FIELD

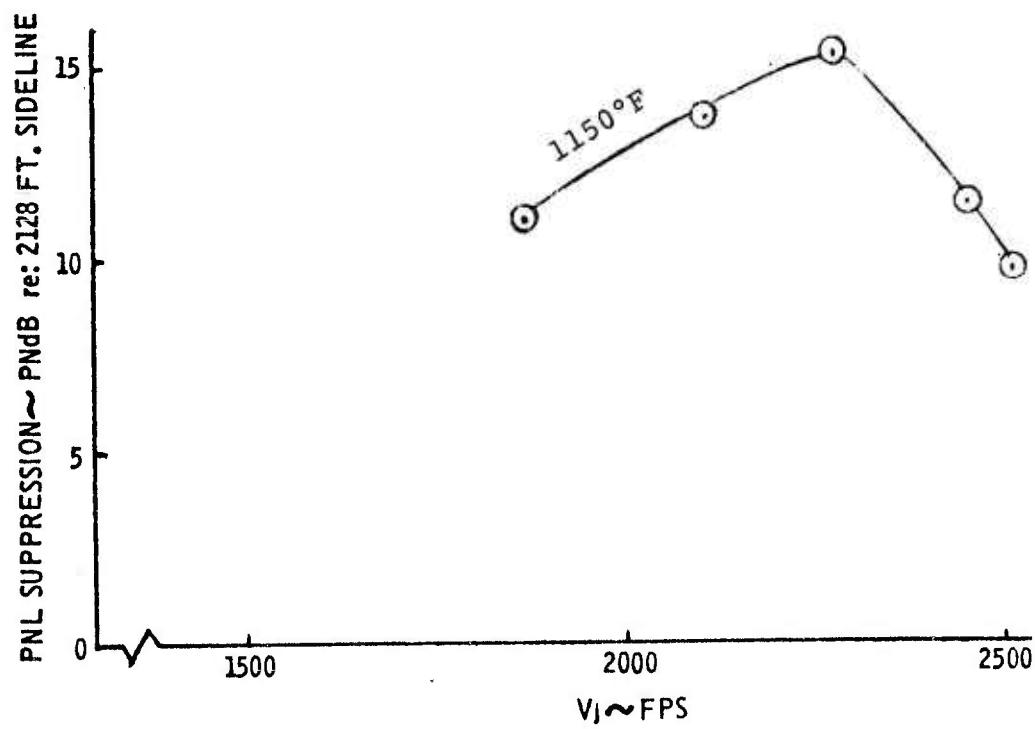
SCALE FACTOR = 8

FULL SCALE $A_8 = 6.05 \text{ FT}^2$

$$PNL_{MAX} - 10 \log D^2 \sim PNDB \text{ re } 2128 \text{ FT, SIDELINE}$$

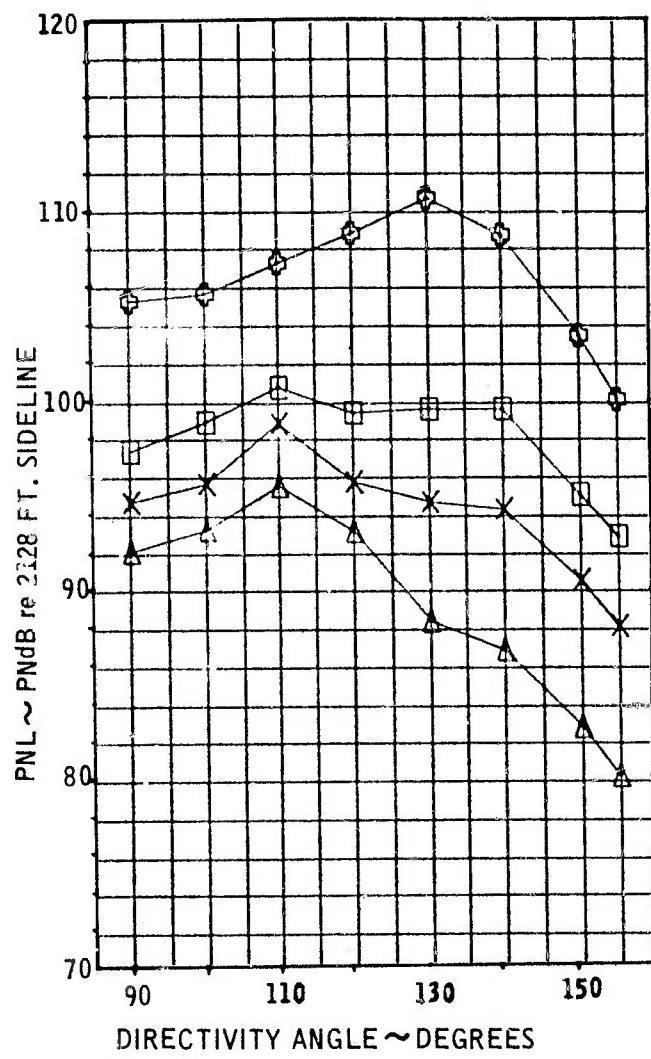


31T-2.75AR-RA-ET/RC WITH 2.6AR EJECTOR



PEAK PNL SUPPRESSION VALUES

NOZZLE: 31T-2.75AR-RA-ET/RC
WITH 2.6AR EJECTOR

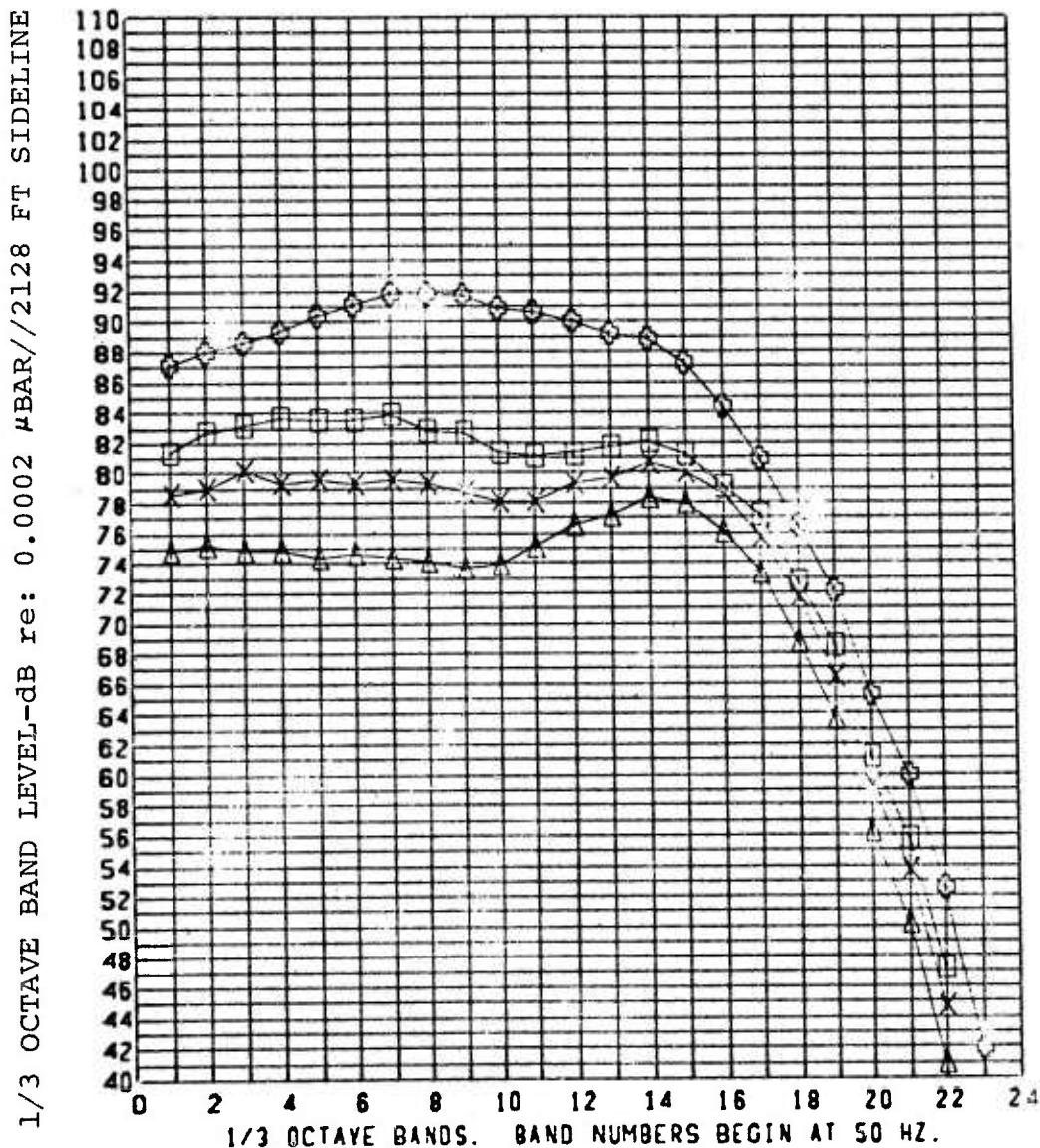


TT = 1150°F A₈ = 6.05 FT² RUN: 65
PR = △ 2.0, × 2.5, □ 3.0, + 4.0

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

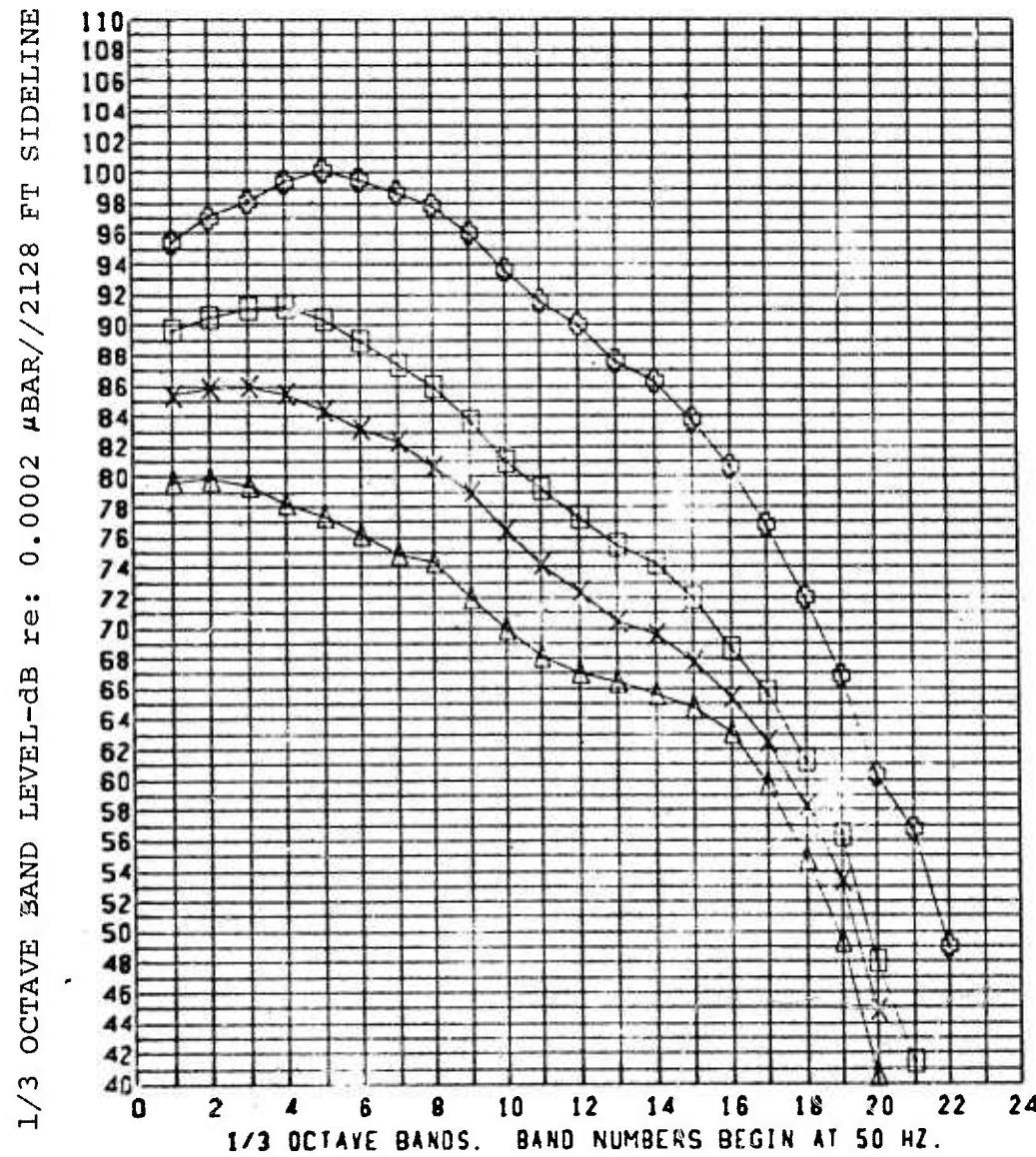
ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 65

PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 4.0 \diamond 3.7

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 65
PR = Δ 2.0, \times 2.5, \square 3.0, \blacksquare 4.0

TEST CONDITIONS

NOZZLE: 31T-2.75AR-RA-ET/RC
with 3.1AR Ejector

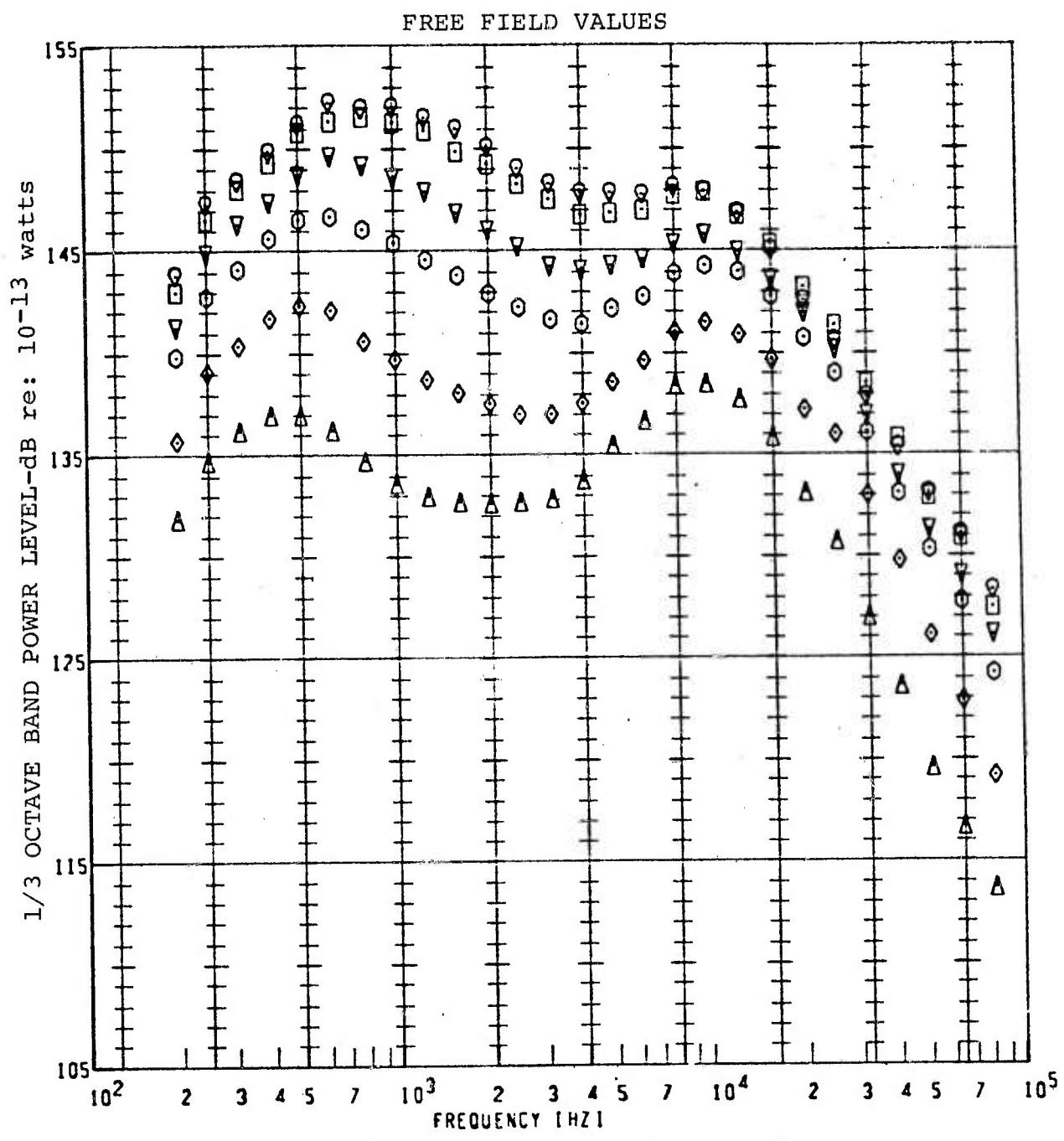
FACILITY: HNTF

DATE: 9-21-73 **T_{AMB}** = 70°F **R.H.** = 58%

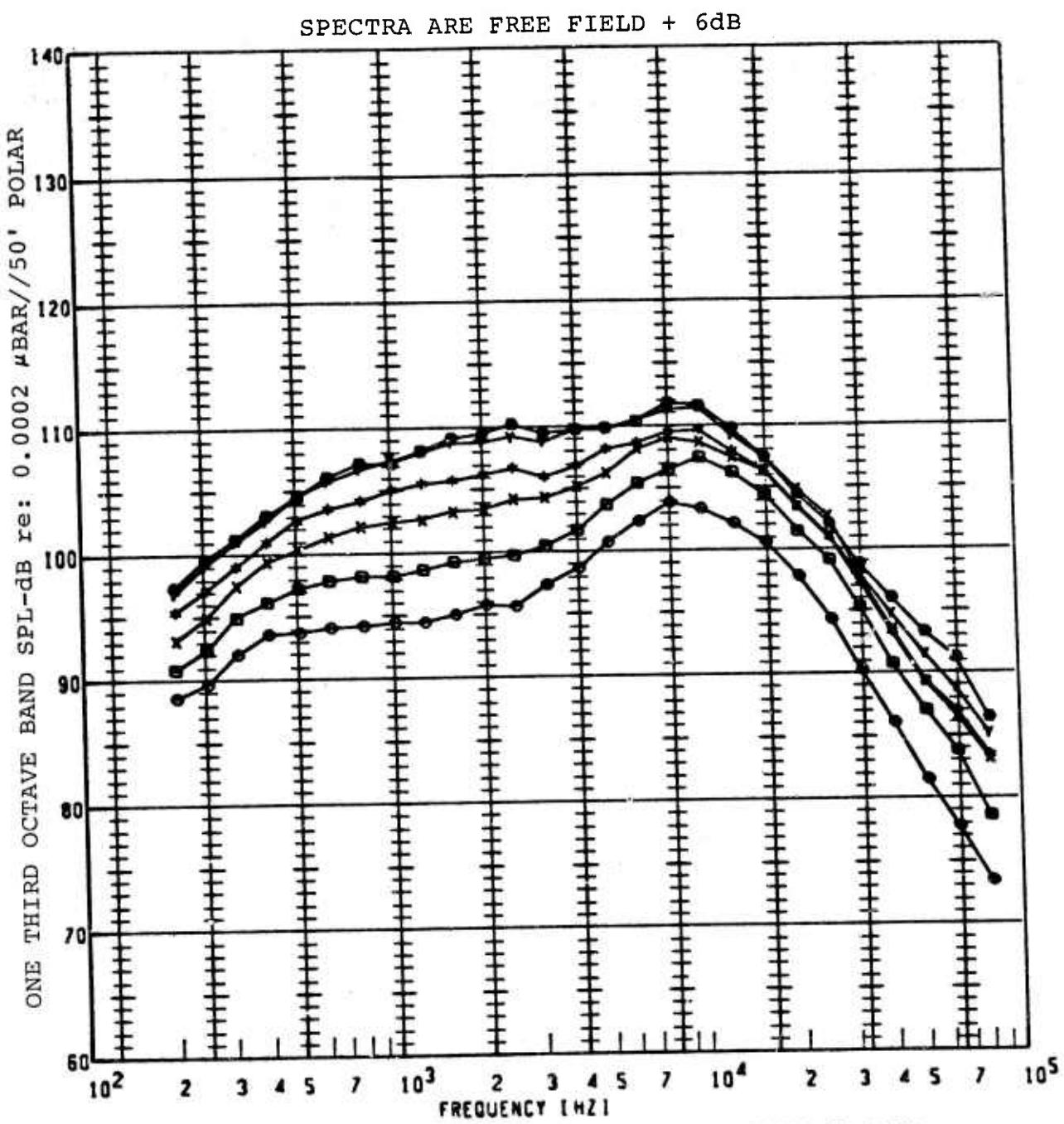
SCALE MODEL A₈ = 13.6 in.²

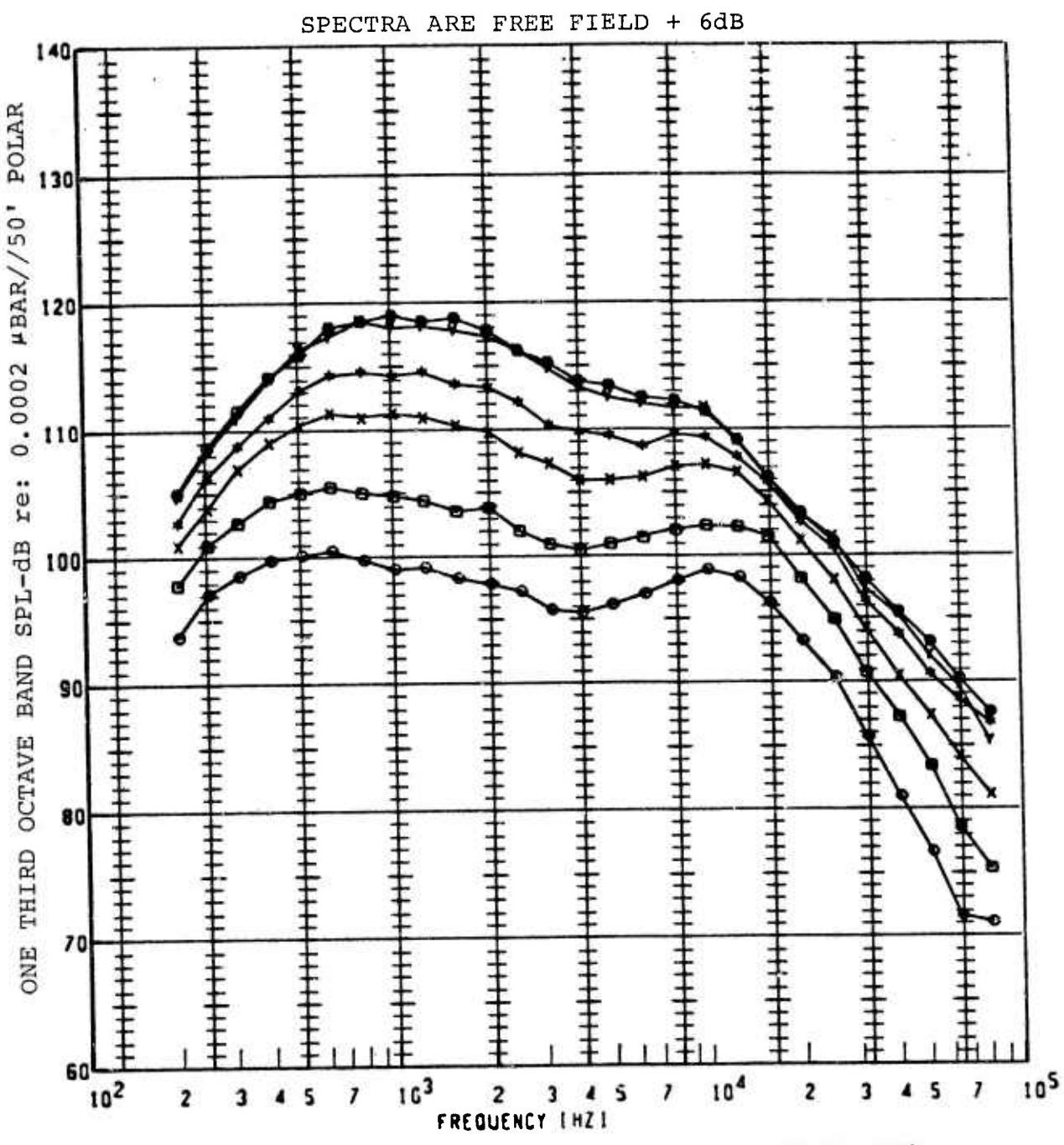
<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
87	2.0	1150°F	1875 fps		
"	2.5	"	2126		
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



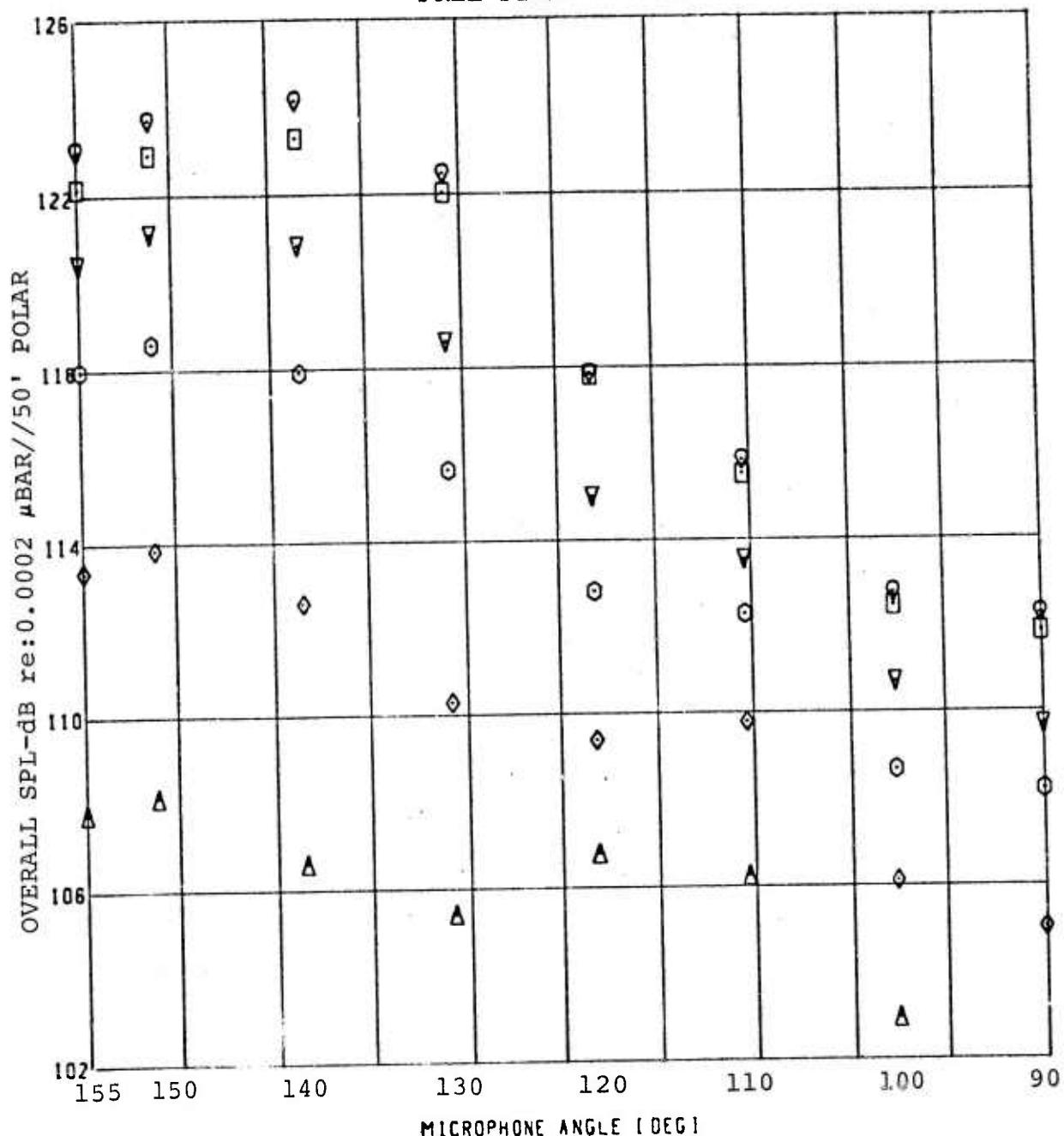
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
▲	87	2.00	1150°
◇	87	2.50	1150
○	87	3.00	1150
▽	87	3.40	1150
□	87	3.70	1150
◆	87	4.00	1150



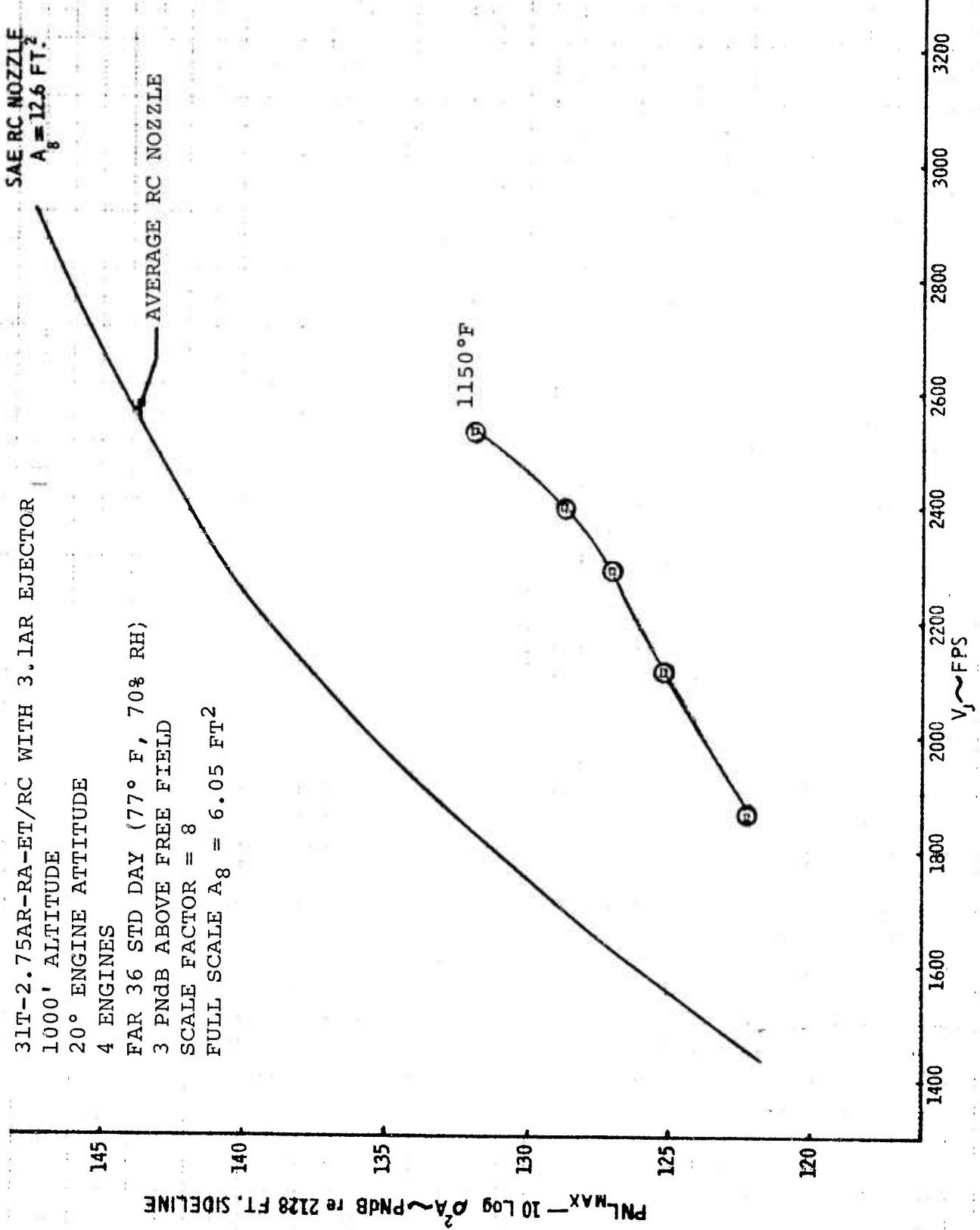


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL [dB]
○	87G	1150	2.000	130°	SOFP	111.3
●	87G	1150	2.500		SOFP	116.2
×	87G	1150	3.000		SOFP	121.6
*	87G	1150	3.400		SOFP	124.6
◻	87G	1150	3.700		SOFP	128.0
■	87G	1150	4.000		SOFP	128.4

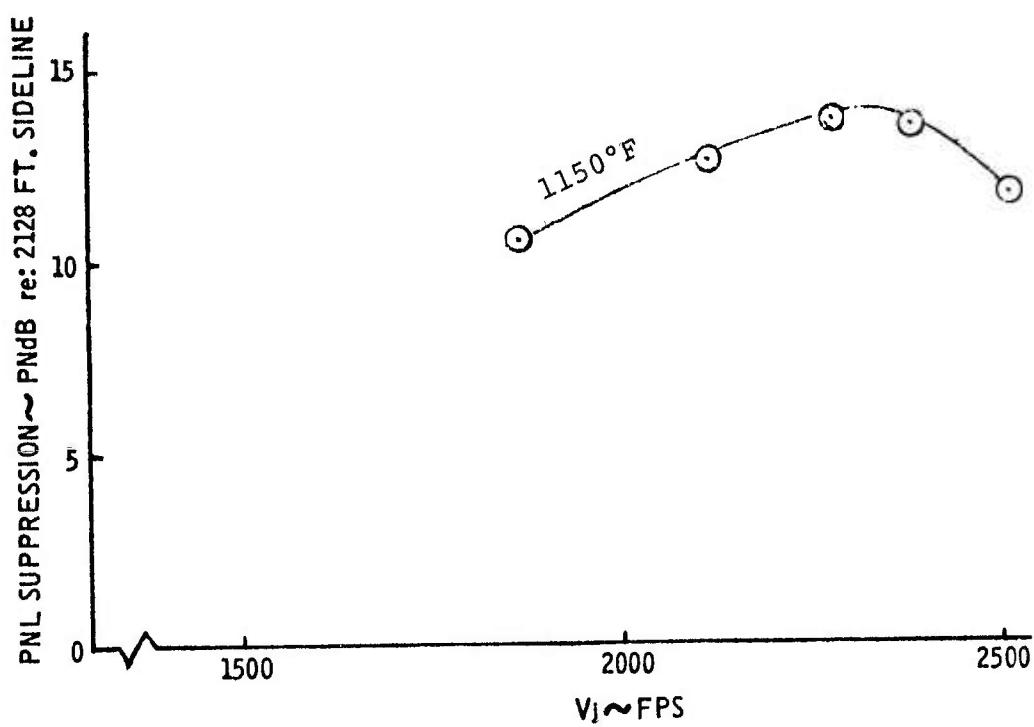
FREE FIELD VALUES



31T-2.75AR-RA-ET/RC WITH 3.1AR EJECTOR
 1000' ALTITUDE
 20° ENGINE ATTITUDE
 4 ENGINES
 FAR 36 STD DAY (77° F, 70% RH)
 3 PNDB ABOVE FREE FIELD
 SCALE FACTOR = 8
 FULL SCALE $A_8 = 6.05 \text{ FT}^2$

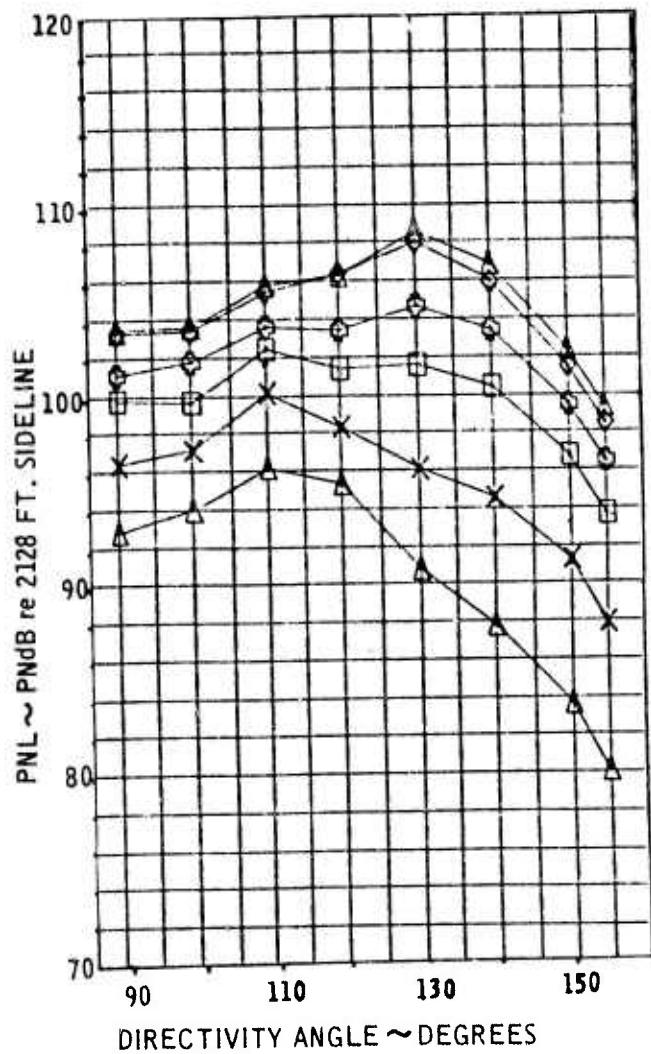


31T-2.75AR-RA-ET/RC WITH 3.1AR EJECTOR



PEAK PNL SUPPRESSION VALUES

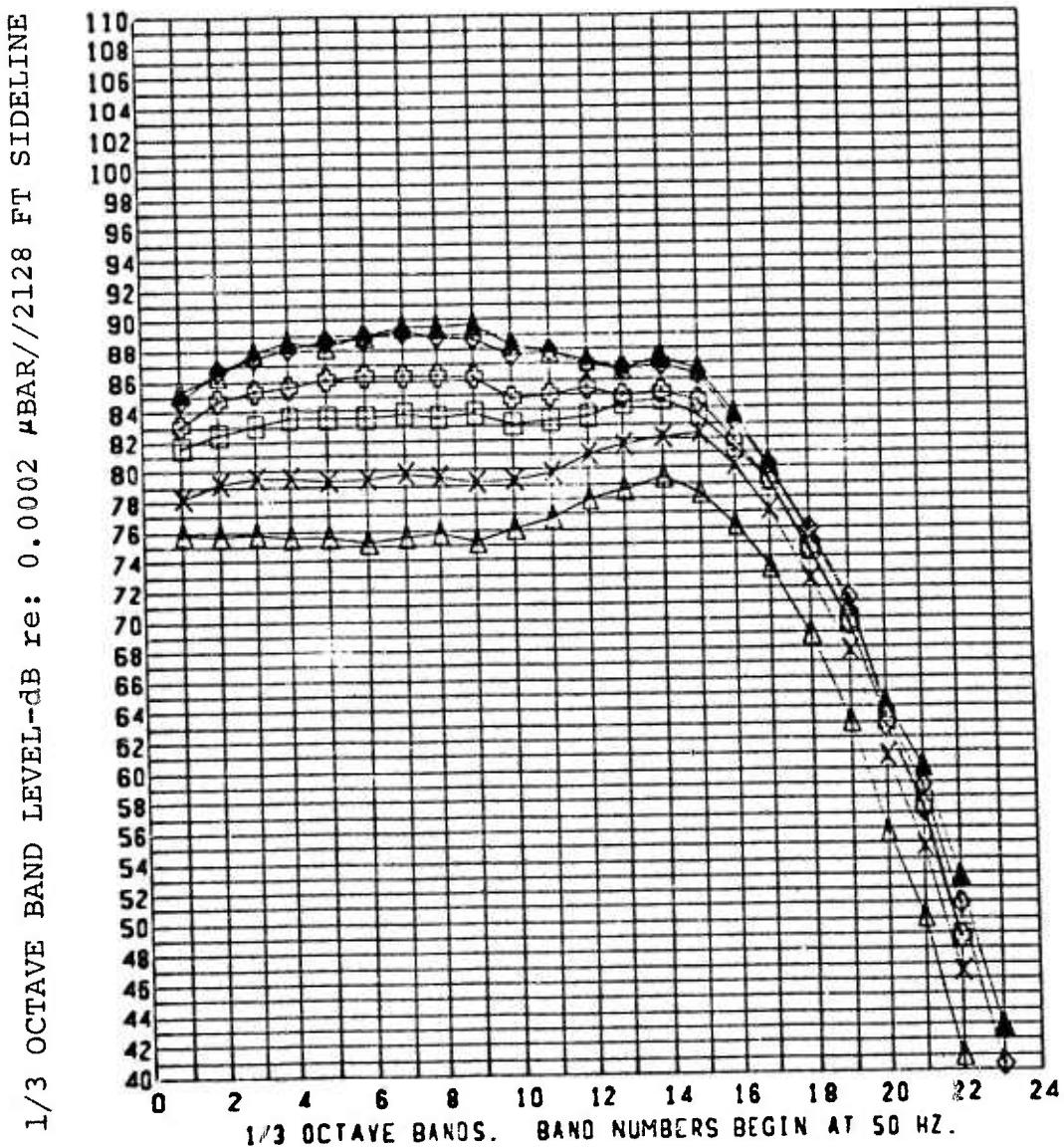
NOZZLE: 31T-2.75AR-RA-ET/RC
WITH 3.1AR EJECTOR



TT = 1150°F A8 = 6.05 FT² RUN: 87
PR = Δ 2.0, X 2.5, □ 3.0, + 3.4, ◊ 3.7, ▲ 4.0

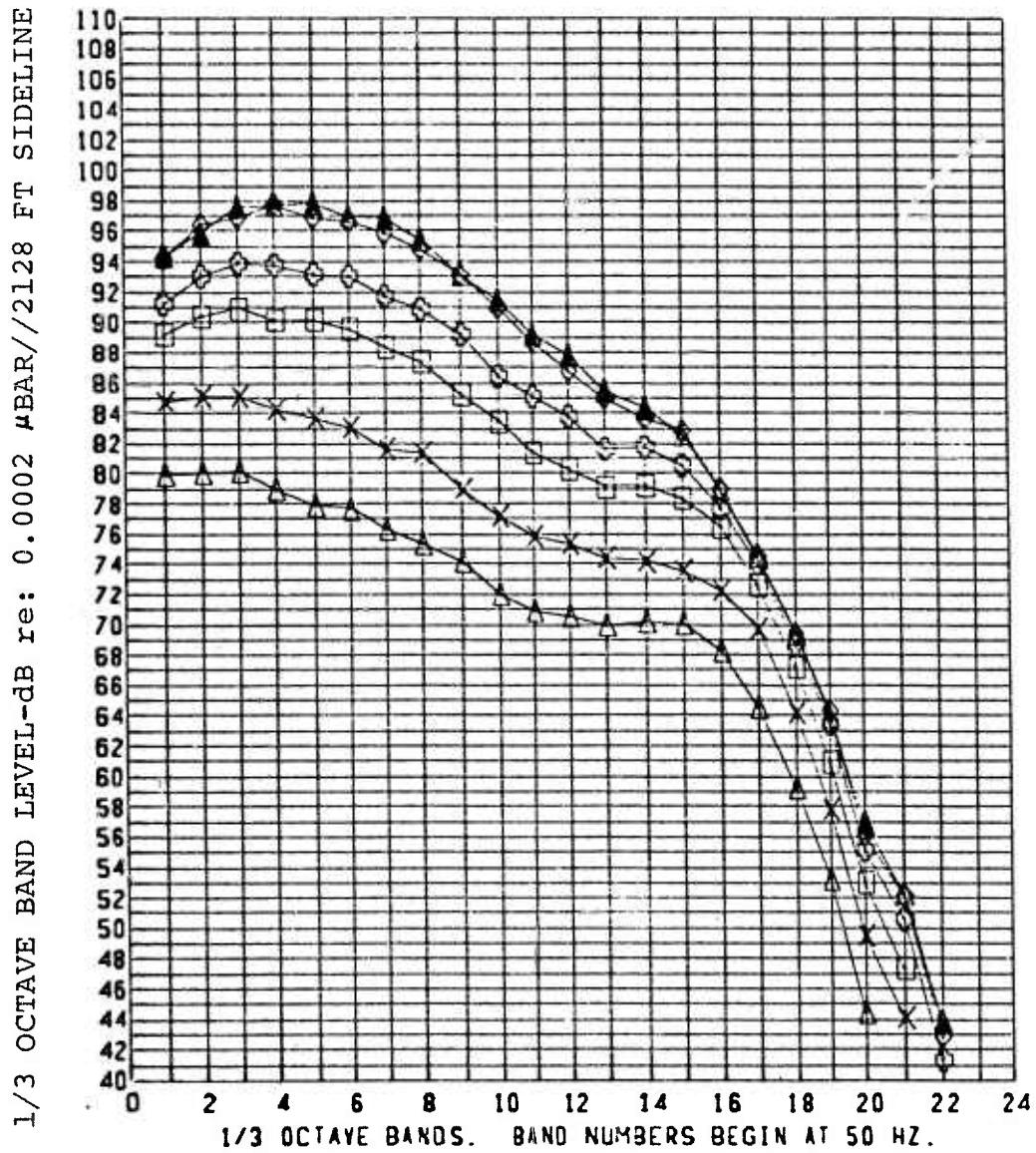
PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 87

PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 3.4, \diamond 3.7, \blacktriangle 4.0

TEST CONDITIONS

NOZZLE: 31T-2.75AR-RA-ET/RC
with 3.7AR Ejector

FACILITY: HNTF

DATE: 9-18-73

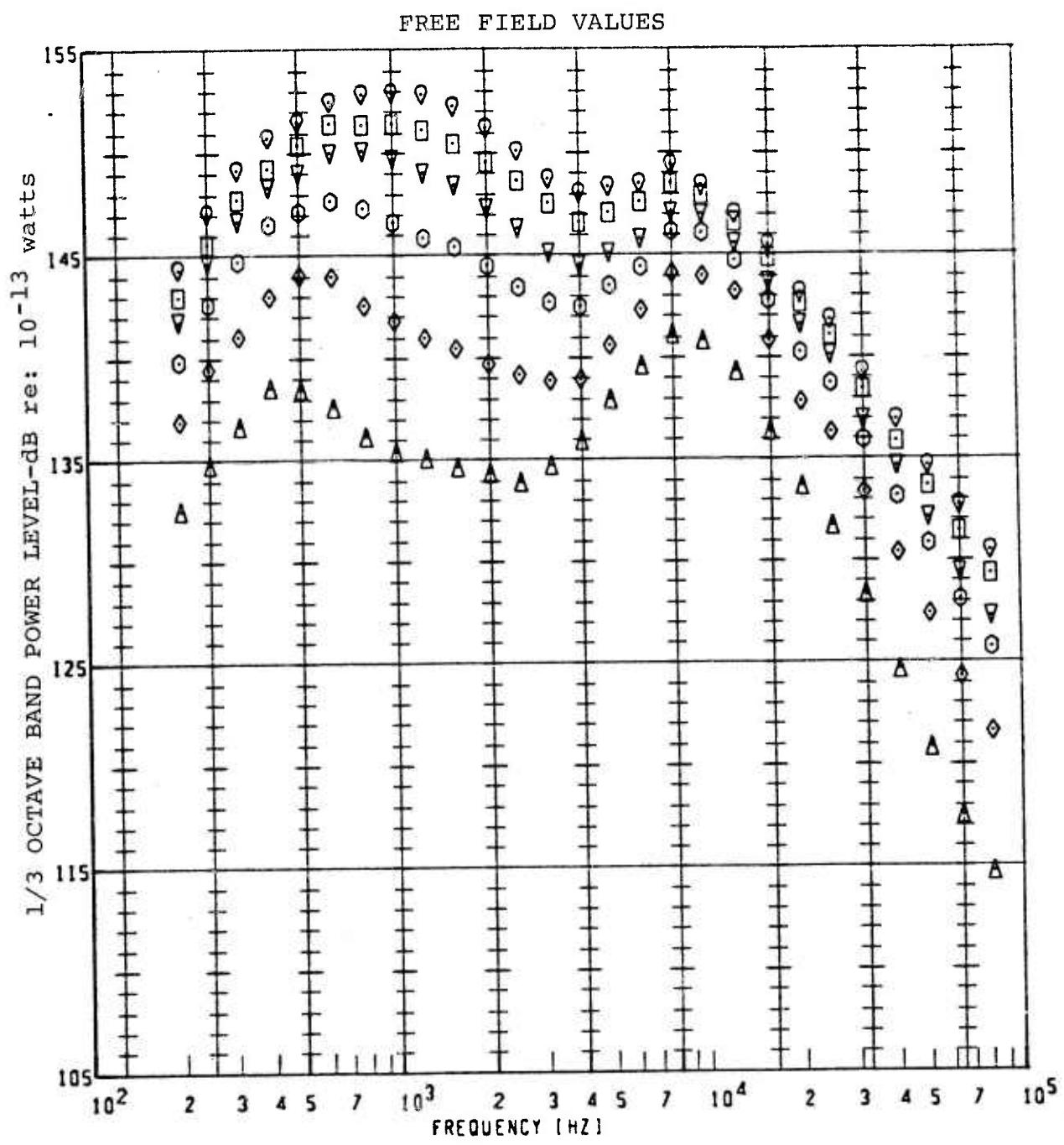
T_{AMB} = 66°F

R.H. = 66%

SCALE MODEL A₈ = 13.6 in.²

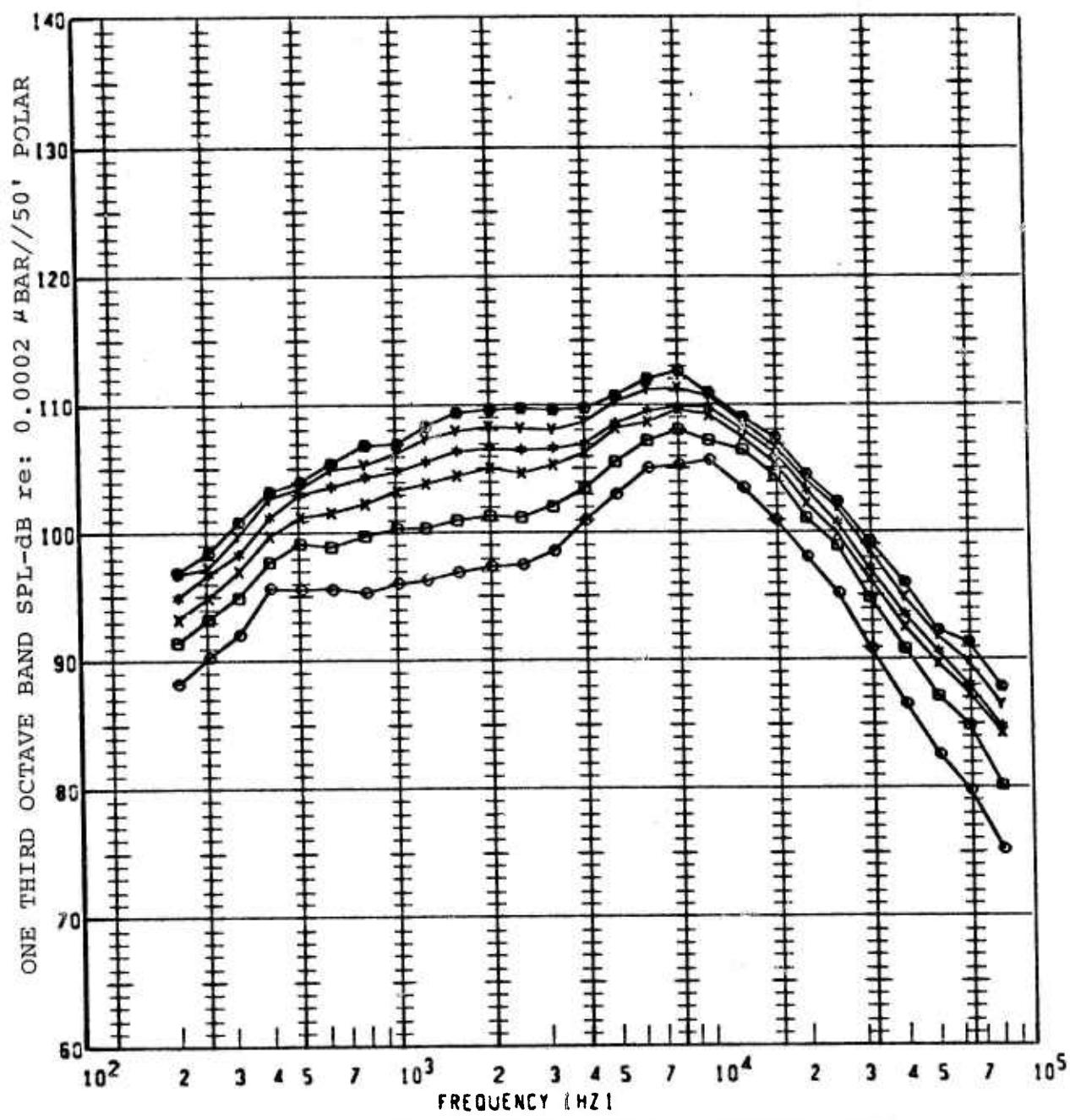
<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
81	2.0	1150°F	1875 fps		
"	2.5	"	2126		
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



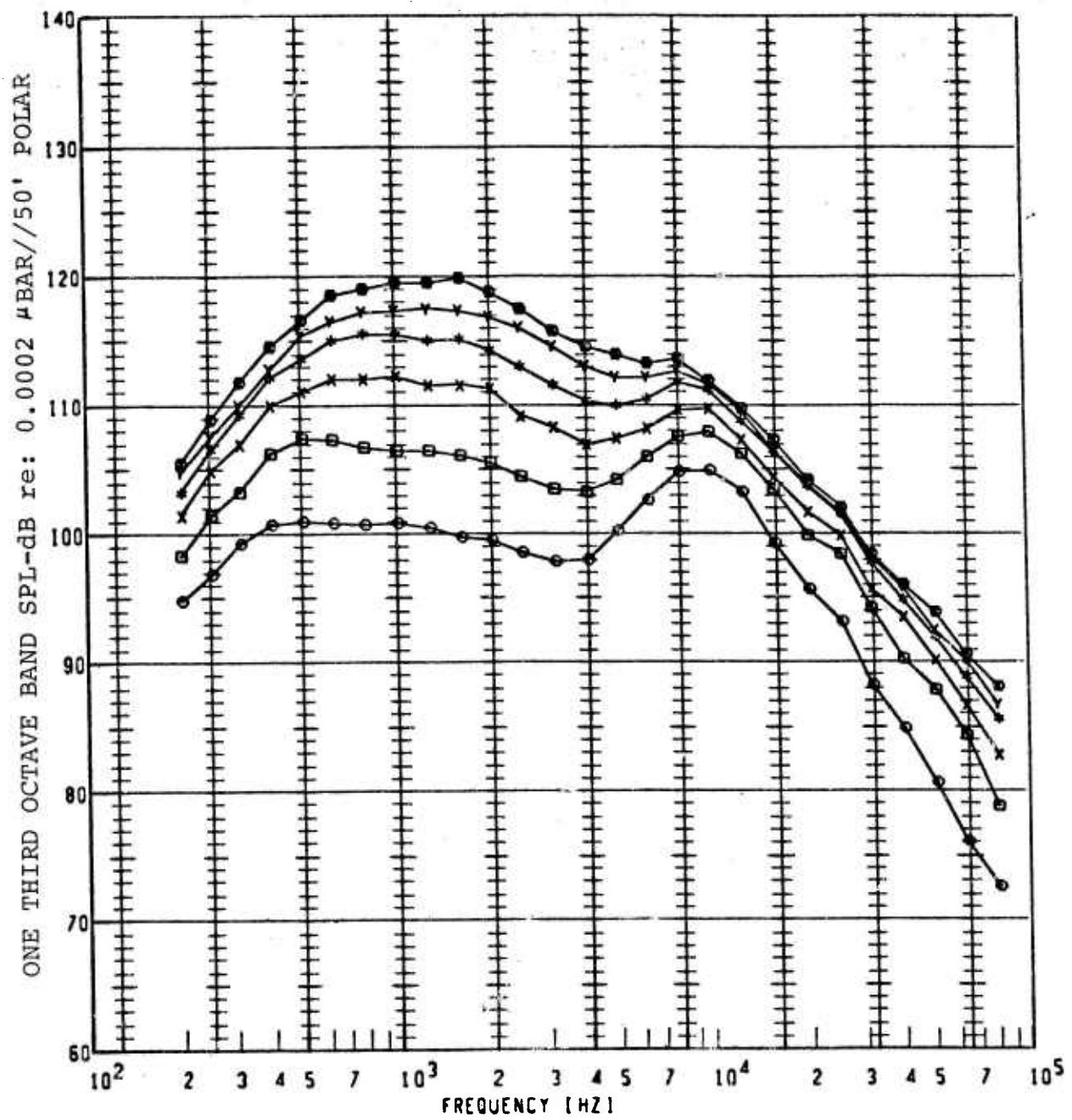
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
▲	81	2.00	1150°F
◆	81	2.50	1150
○	81	3.00	1150
▼	81	3.40	1150
□	81	3.70	1150
◊	81	4.00	1150

SPECTRA ARE FREE FIELD + 6dB



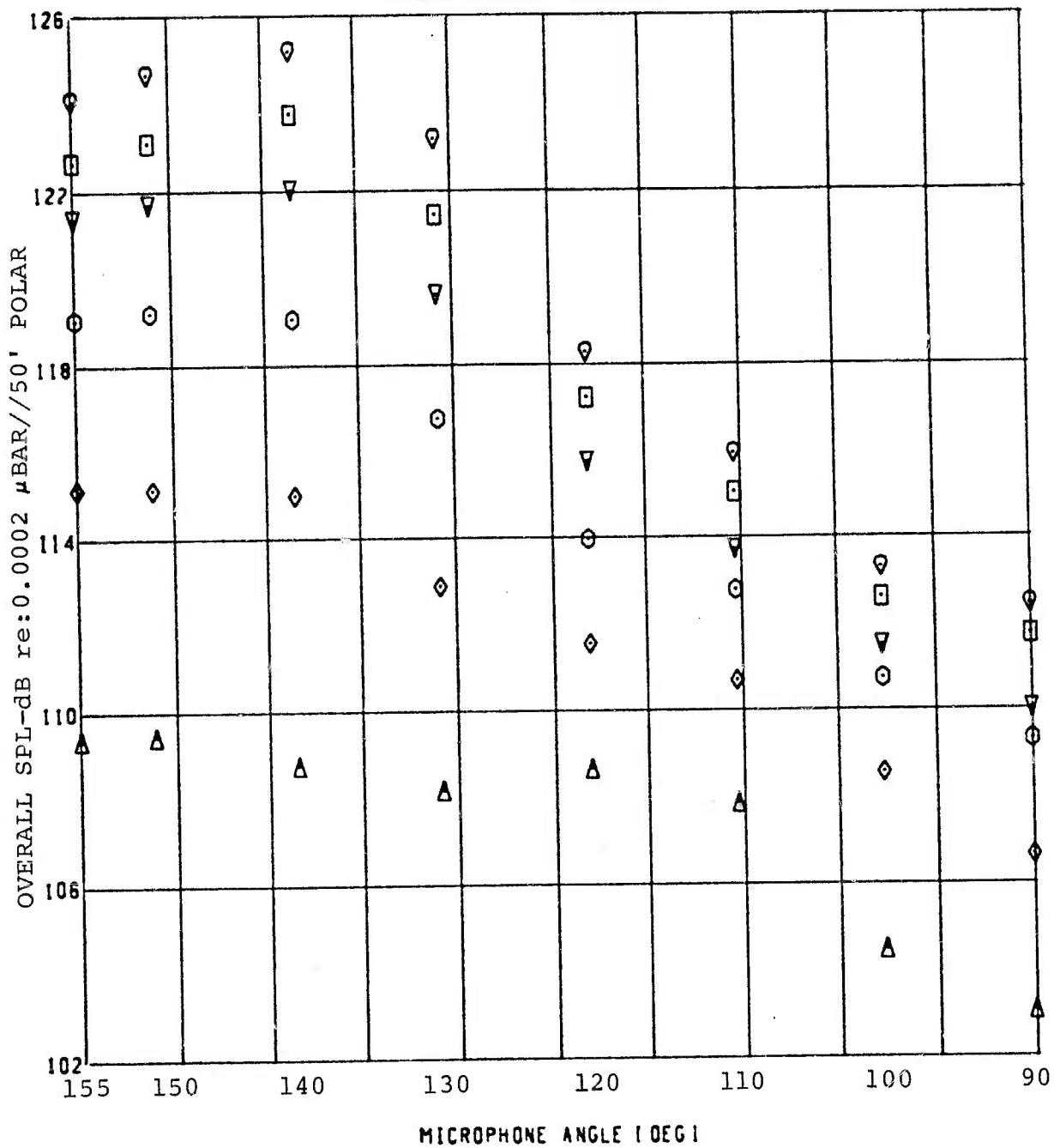
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL (dB)
●	81G	1150°F	2.000	110°	50FP	113.6
■	81G	1150	2.500		50FP	116.4
×	81G	1150	3.000		50FP	118.5
*	81G	1150	3.400		50FP	119.5
▼	81G	1150	3.700		50FP	120.9
●	81G	1150	4.000		50FP	121.8

SPECTRA ARE FREE FIELD + 6dB



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL 1081
○	81G	1150° F	2.000	130°	SOFP	114.0
◎	81G	1150	2.500		SOFP	118.7
x	81G	1150	3.000		SOFP	122.7
*	81G	1150	3.400		SOFP	125.6
y	81G	1150	3.700		SOFP	127.4
●	81G	1150	4.000		SOFP	129.2

FREE FIELD VALUES



31T-2.75AR-RA-ET/RC WITH 3.7AR EJECTOR

1000' ALTITUDE

20° ENGINE ATTITUDE

4 ENGINES

FAR 36 STD DAY (77° F, 70% RH)

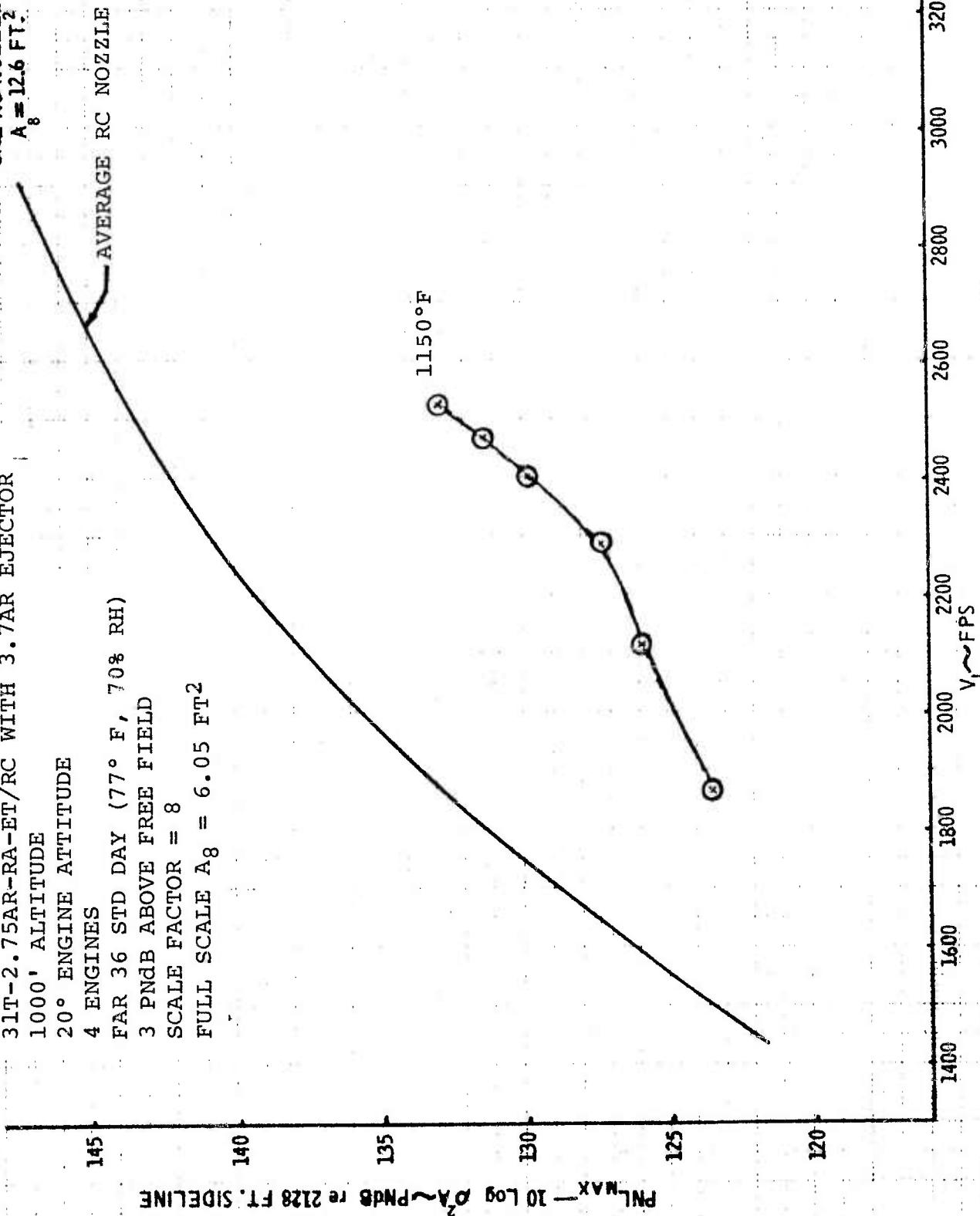
3 PNDB ABOVE FREE FIELD

SCALE FACTOR = 8

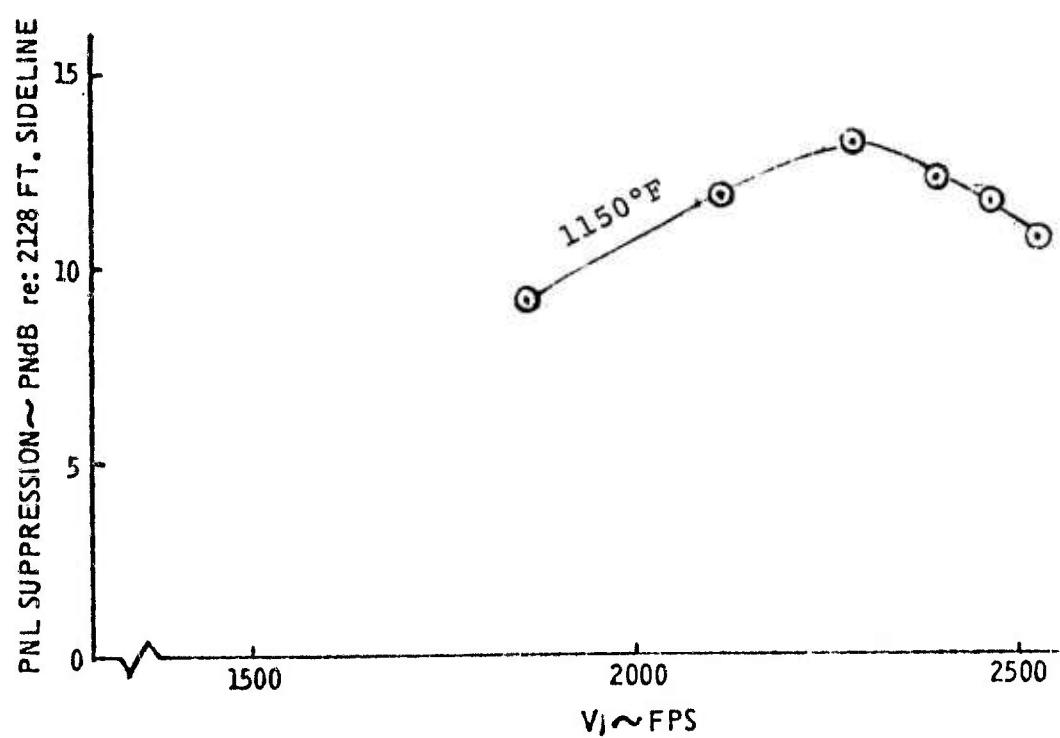
FULL SCALE $A_8 = 6.05 \text{ FT}^2$

SAE RC NOZZLE
 $A_8 = 12.6 \text{ FT}^2$

AVERAGE RC NOZZLE

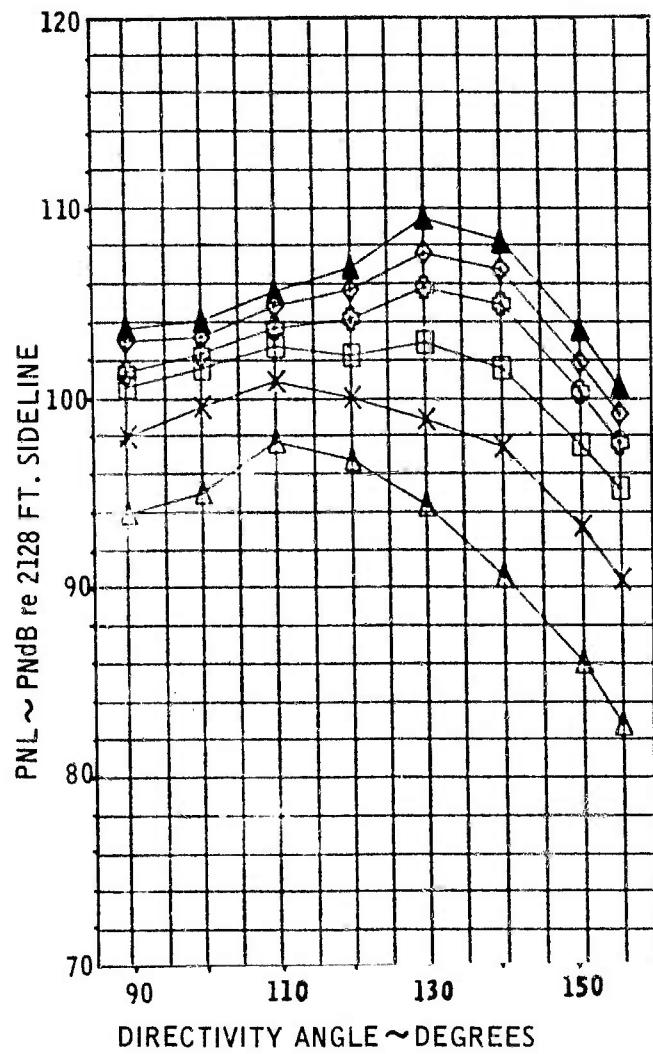


31T-2.75AR-RA-ET/RC WITH 3.7AR EJECTOR



PEAK PNL SUPPRESSION VALUES

NOZZLE: 31T-2.75AR-RA-ET/RC
WITH 3.7AR EJECTOR

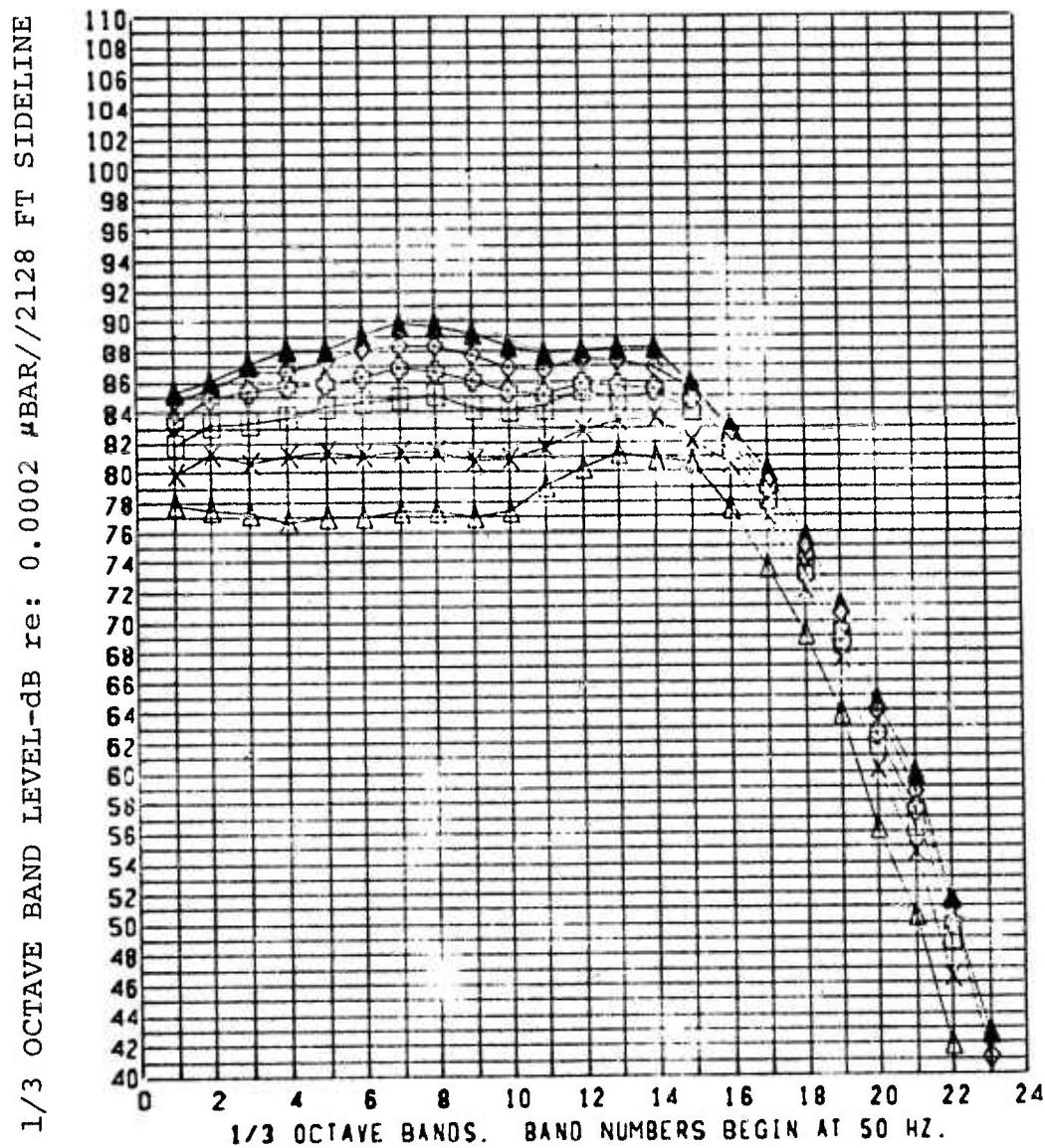


TT = 1150°F A8 = 6.05 FT² RUN: 81
PR = ▲ 2.0, X 2.5, □ 3.0, + 3.4, ◇ 3.7 ▲ 4.0

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

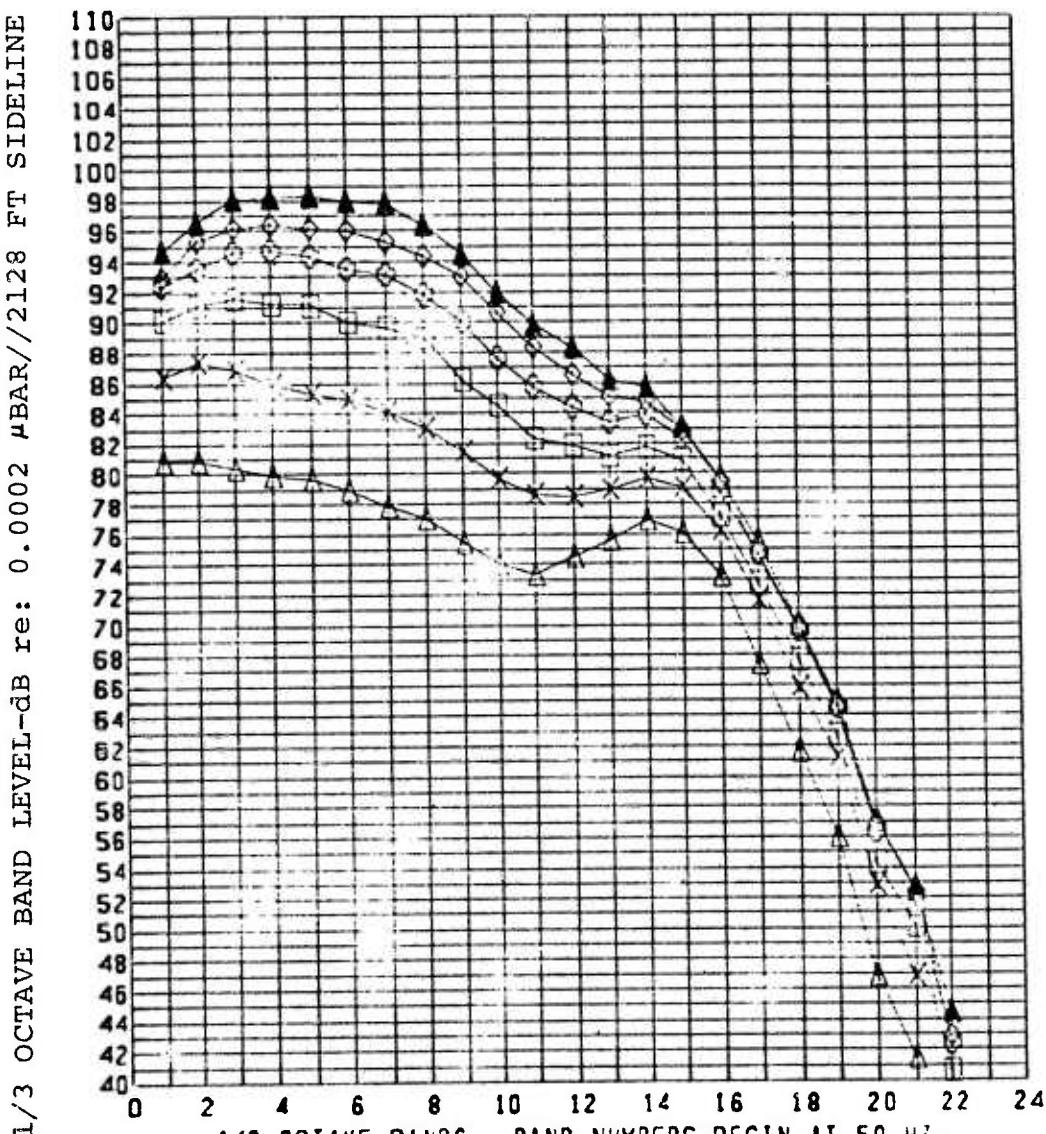
ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 81

PR = △ 2.0, X 2.5, □ 3.0, + 3.4, ◊ 3.7, ▲ 4.0

ALT = 1000 FT, VEL = 0 FPS, S.L. > 2128 FT, 4 ENGINES
ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT

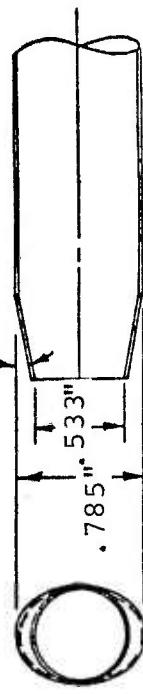


TT = 1150°F A8 = 6.05 FT² RUN: 81
PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.4, \diamond 3.7, \blacktriangle 4.0



42T/ANNULUS-3.3AR-CPA-ET/RC NOZZLE
(0.383" WIDE ANNULUS)

12° NOM.



TUBE MAT'L - .035 WALL, 321 CRES
(FULL SIZE)

HAND GRIND TO FORM
SMOOTH BELLMOUTH
TYPE ENTRIES

CONTOURED
BOATTAIL

T.P.

SYM

TRANSLATING PLUG

20° TYP.
INNER ROW

15°
OUTER ROW

15° TYP.

20° TYP.

12°

3.39" R

1.952" R

1.569" R

2.536" R

4.00" DIA.

TOTAL PRIMARY
FLOW AREA = 13.59 IN.²

42 TUBE - ANNULAR-PLUG NOZZLE

TEST CONDITIONS

NOZZLE: 42T/Annulus-3.3AR-CPA-ET/RC

FACILITY: HNTF

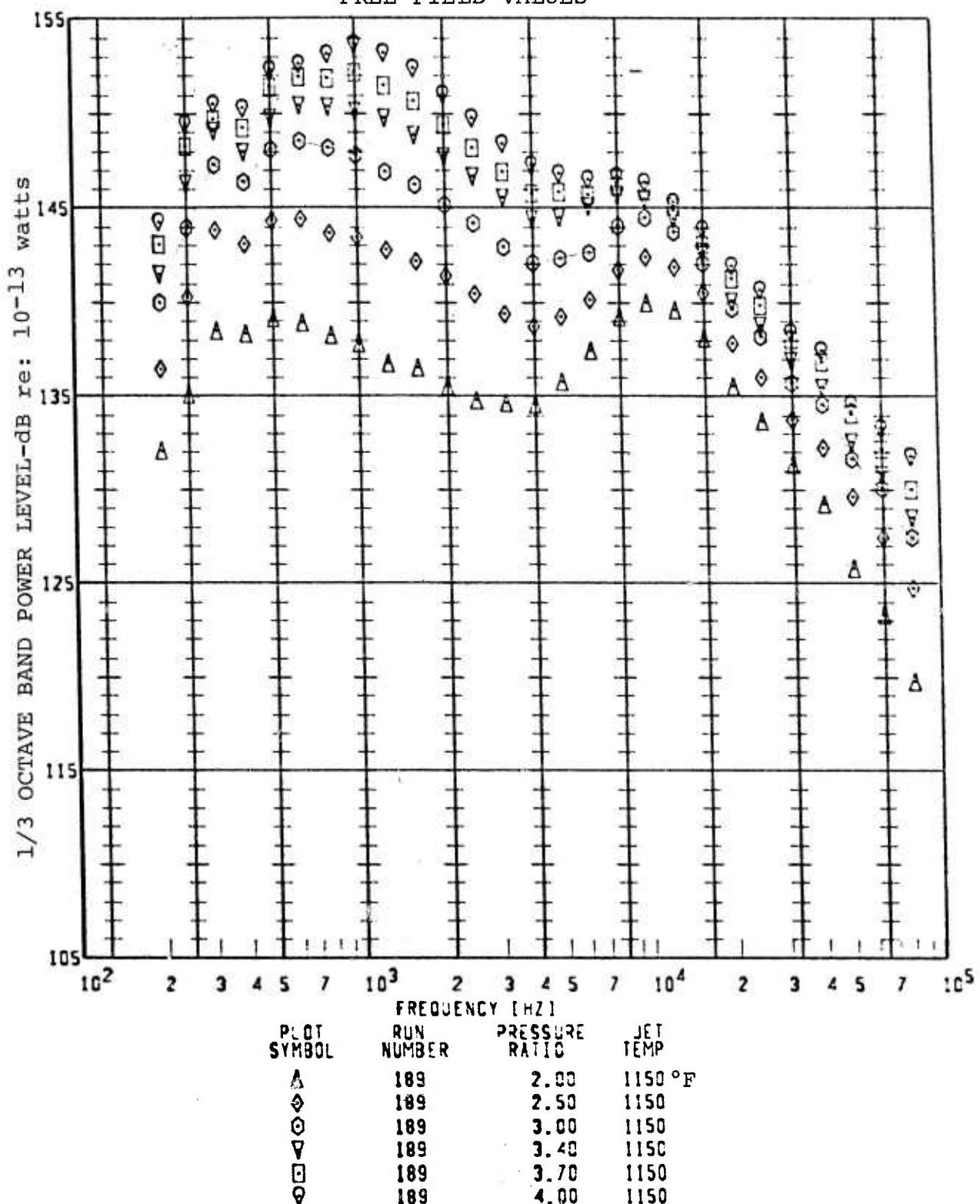
DATE: 10-19-73 **T_{AMB}** = 65°F **R.H.** = 62%

SCALE MODEL A₈ = 13.6 in.²

RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
189	2.0	1150°F	1875 fps	Annulus width =	
"	2.5	"	2126	0.383"	
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

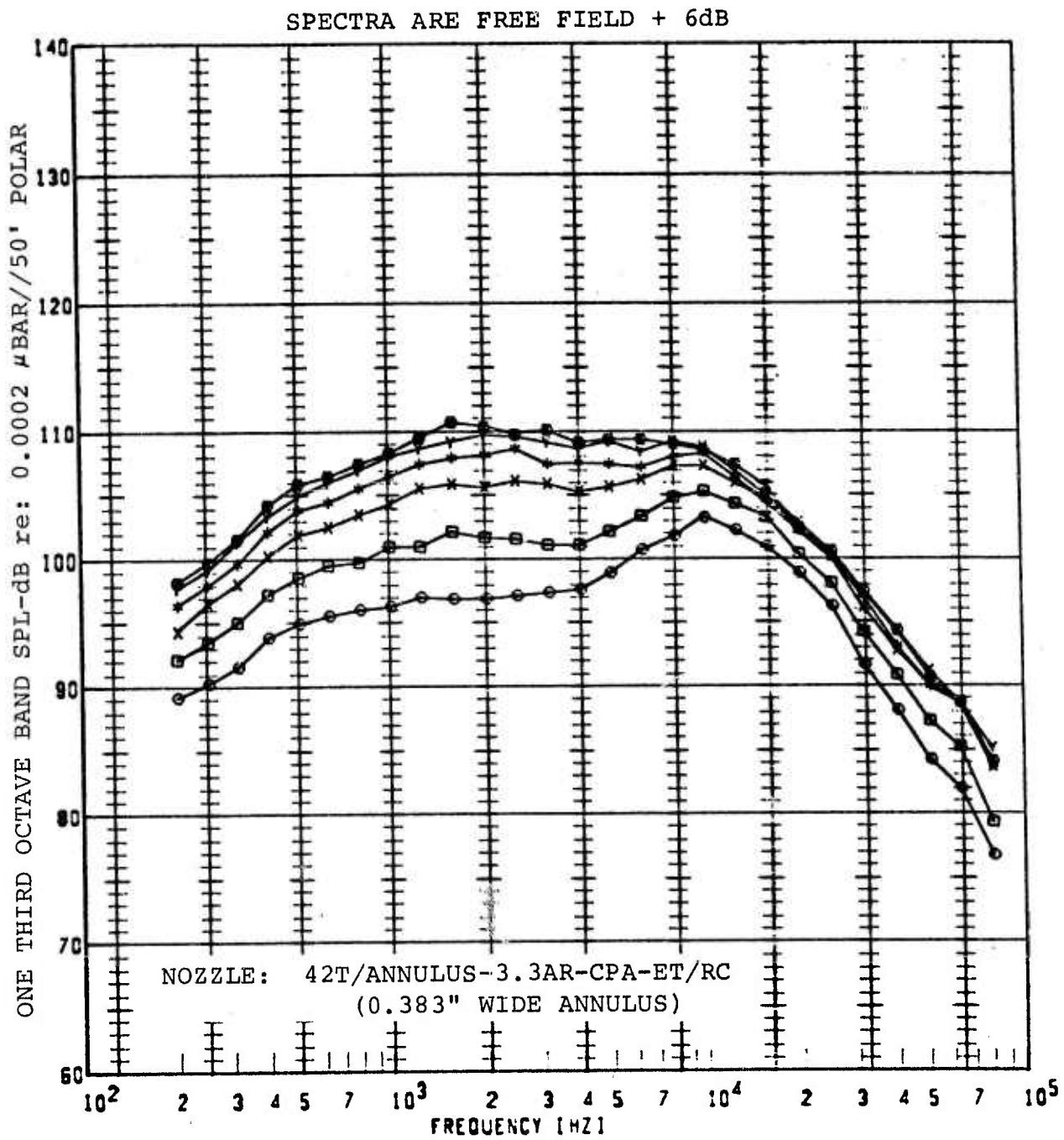
MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

FREE FIELD VALUES



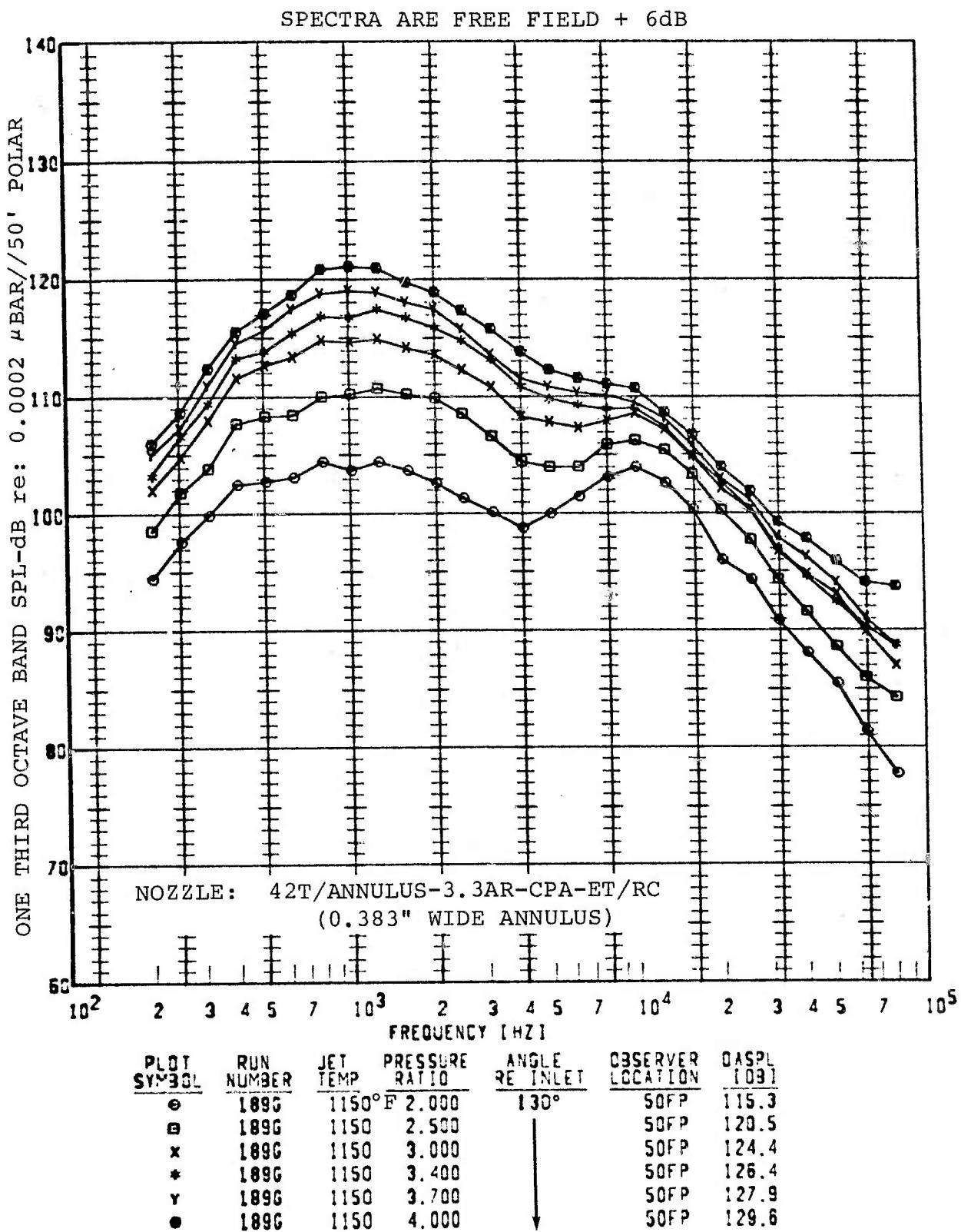
NOZZLE: 42T/ANNULUS-3.3AR-CPA-ET/RC
(0.383" WIDE ANNULUS)

JET NOISE POWER SPECTRA

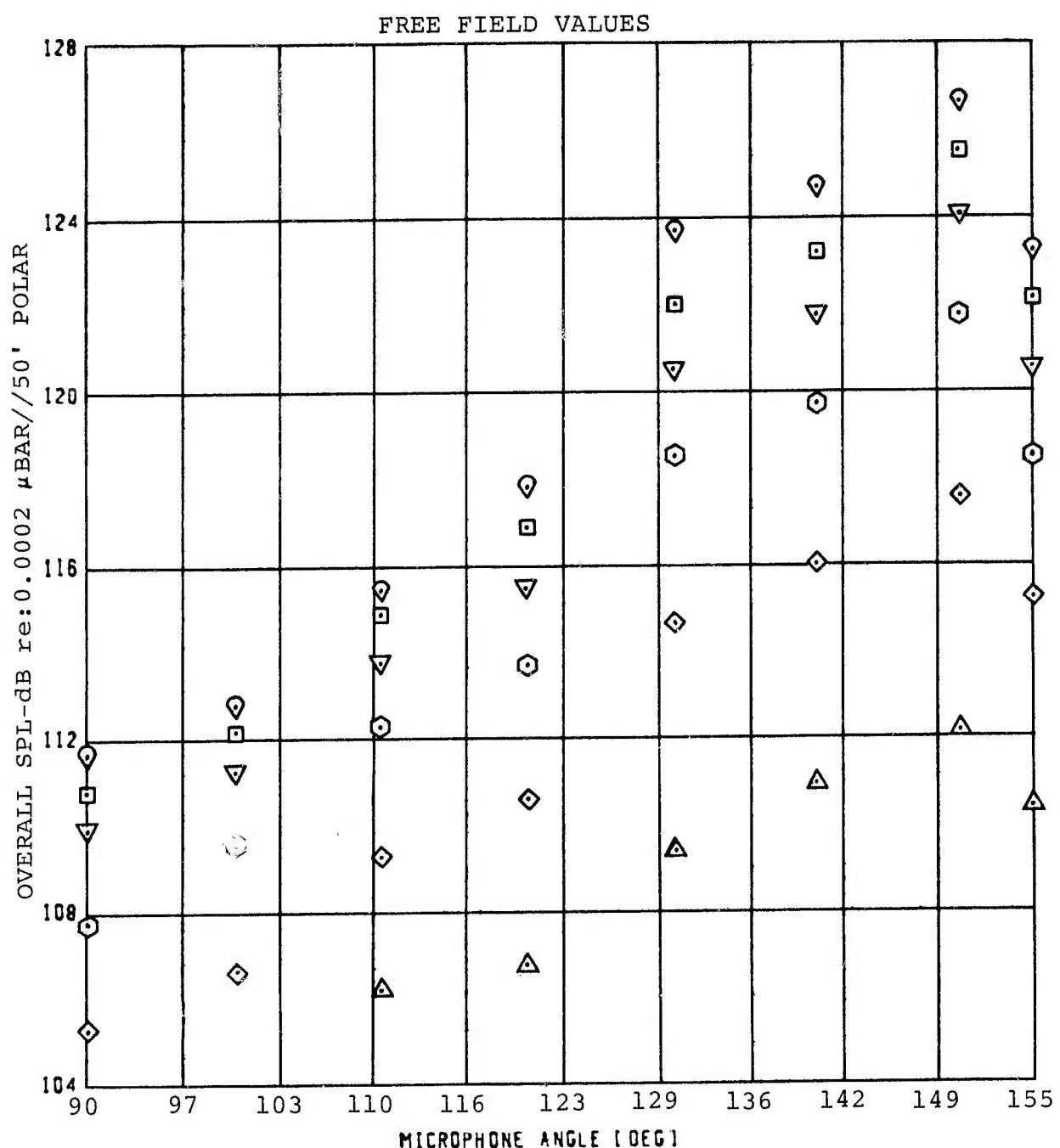


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [dB]
○	189G	1150°F	2.000	110°	SOFP	111.0
□	189G	1150	2.500		SOFP	114.5
×	189G	1150	3.000		SOFP	116.0
*	189G	1150	3.400		SOFP	119.5
▽	189G	1150	3.700		SOFP	120.7
●	189G	1150	4.000		SOFP	121.2

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



NOZZLE: 42T/ANNULUS-3.3AR-CPA-ET/RC
(0.383" WIDE ANNULUS)

OASPL BEAM PATTERNS

SAE RC NOZZLE
 $A_g = 12.6 \text{ FT}^2$

42T/ANNULUS-3.3MR-CPA-ET/RC (0.383" WIDE ANNULUS)

1000' ALTITUDE

20° ENGINE ATTITUDE

4 ENGINES

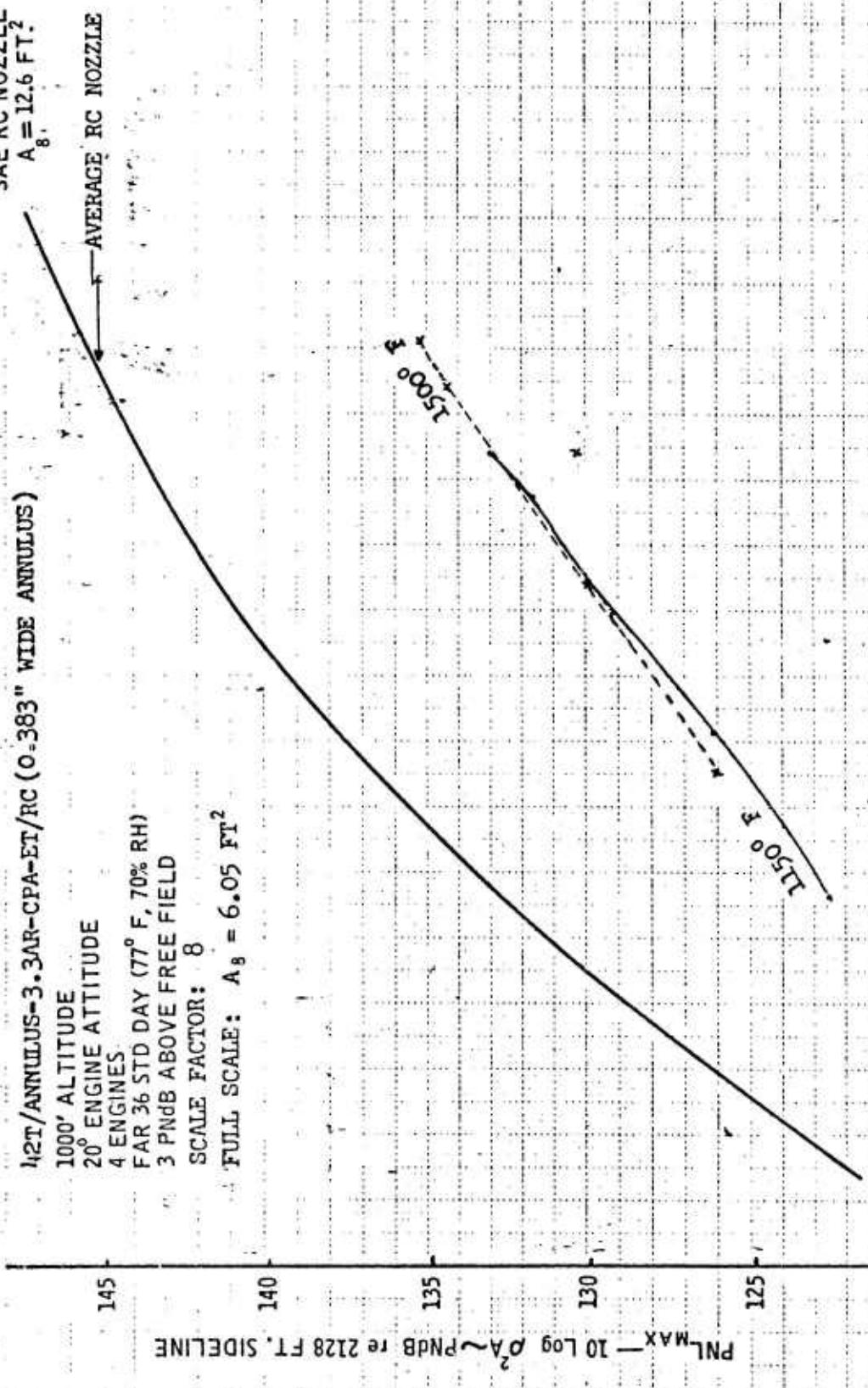
FAR 36 STD DAY (77° F, 70% RH)

3 PNdB ABOVE FREE FIELD

SCALE FACTOR: 8

FULL SCALE: $A_g = 6.05 \text{ FT}^2$

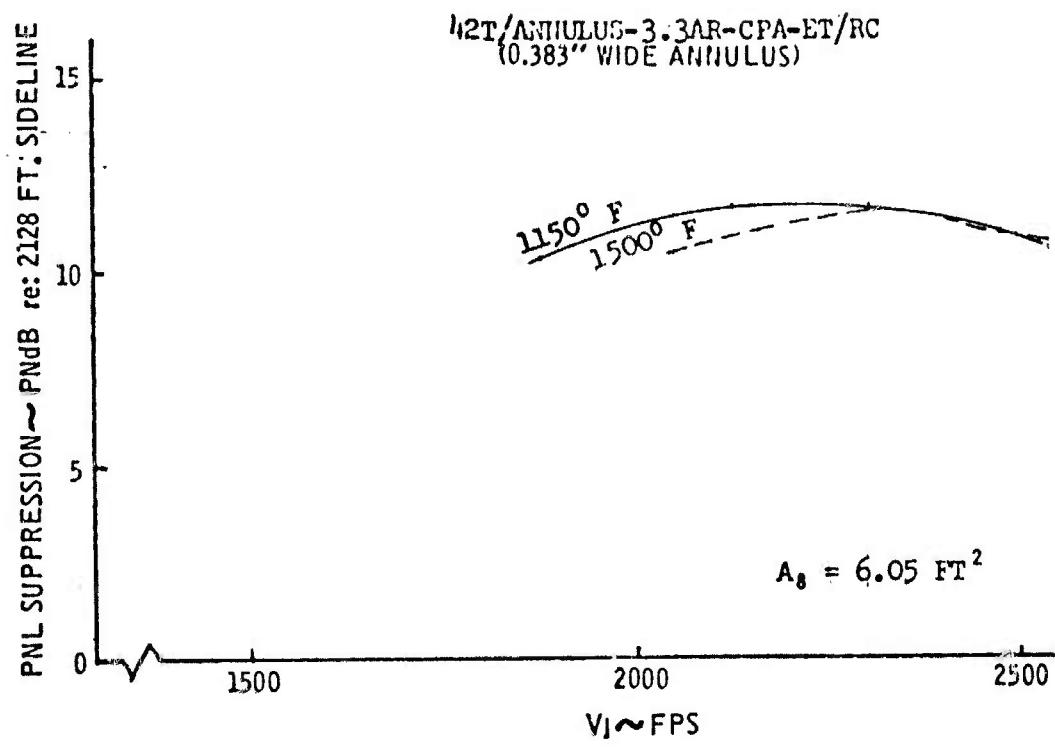
AVERAGE RC NOZZLE



"NORMALIZED" 2128 FT. SIDELINE PNL

120

1400 1600 1800 2000 2200 2400 2600 2800 3000 3200

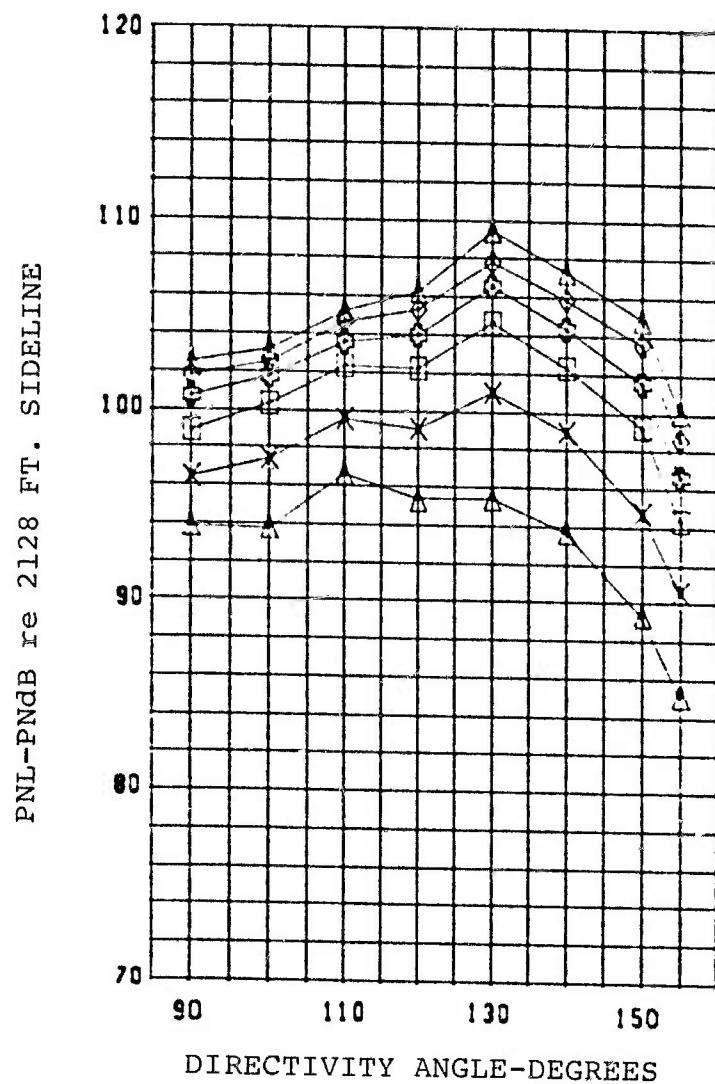


PEAK PNL SUPPRESSION VALUES

NOZZLE: 42T/ANNULUS-3.3AR-CPA-ET/RC
(0.383" WIDE ANNULUS)

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = TEMP = 77 DEG R.H. = 70 PER CENT

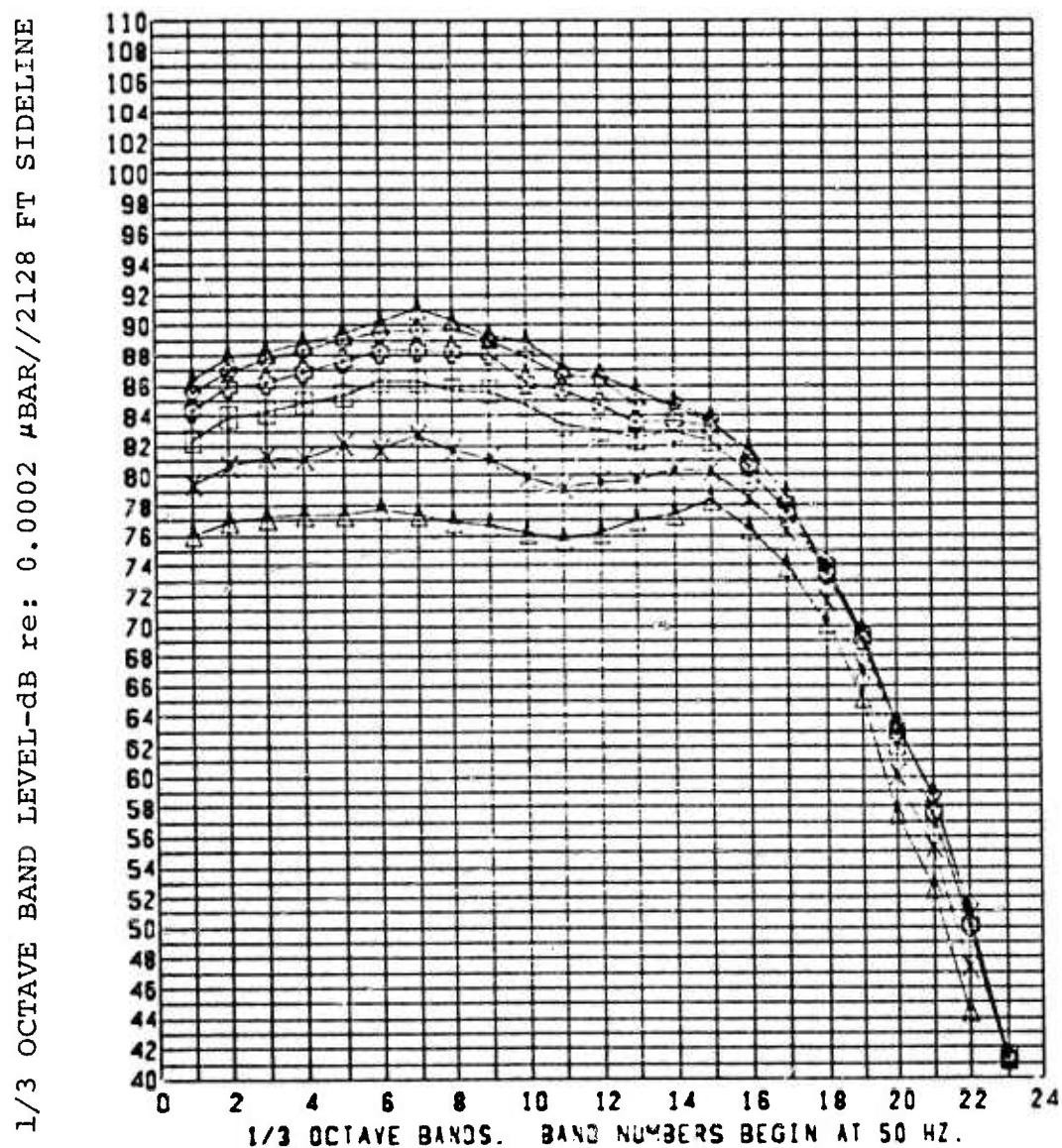


TT = 1150°F A8 = 6.05 FT² RUN: 189
PR = △ 2.0, × 2.5, □ 3.0, + 3.4, ◇ 3.7, ▲ 4.0

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 189

PR = ▲ 2.0, X 2.5, □ 3.0, + 3.4, ◇ 3.7, ▲ 4.0

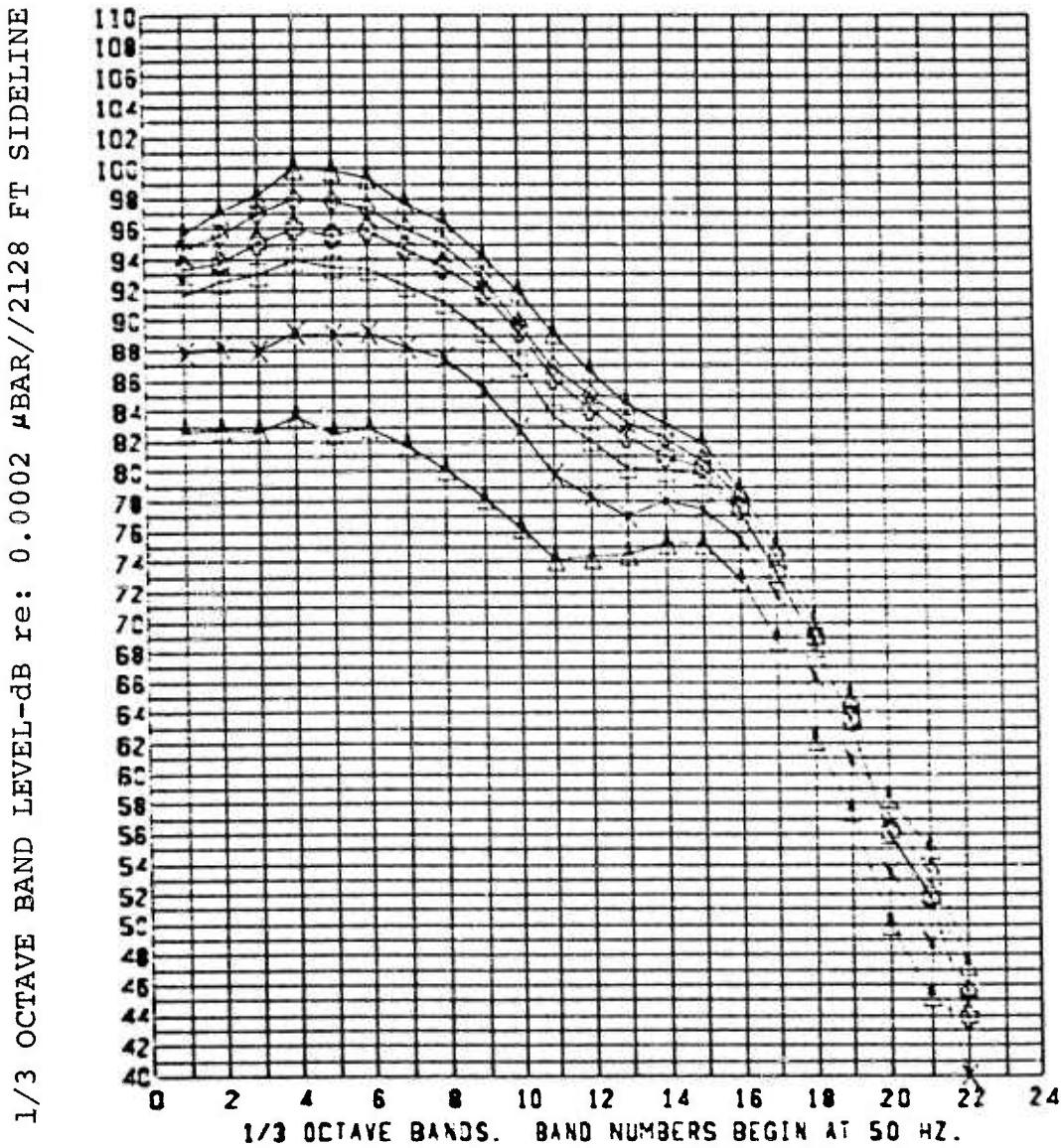
NOZZLE: 42T/ANNULUS-3.3AR-CPA-ET/RC
(0.383" WIDE ANNULUS)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°

re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.05 FT² RUN: 189

PR = △ 2.0, X 2.5, □ 3.0, + 3.4, ◇ 3.7, ▲ 4.0

NOZZLE: 42T/ANNULUS-3.3AR-CPA-ET/RC
(0.383" WIDE ANNULUS)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°
re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 42T/ANNULUS-3.3AR-ET/RC
(0.383" WIDE ANNULUS AND CENTER BODY)

FACILITY: WALL ISOLATION FACILITY

DATE: December 21, 1973

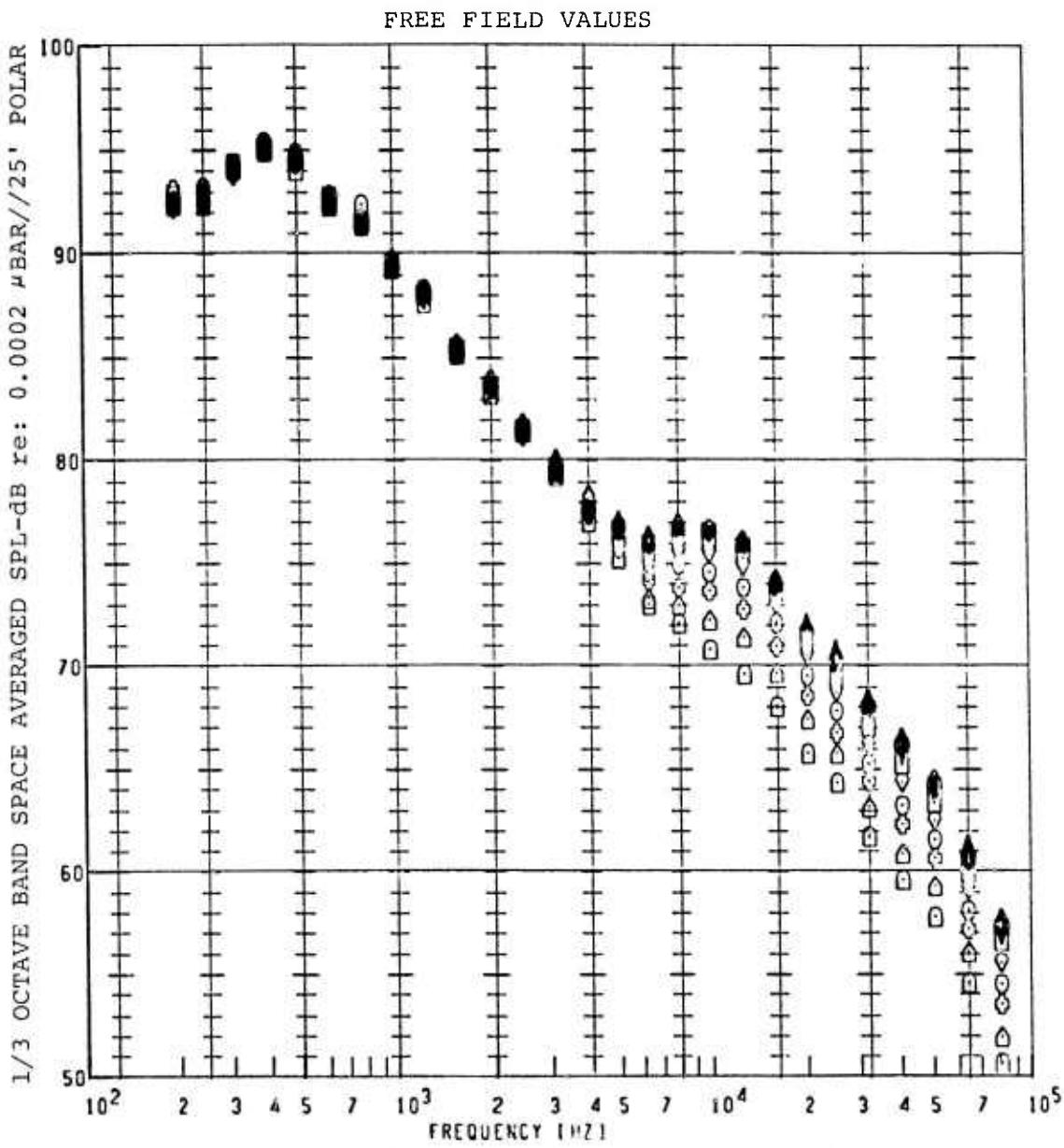
P_{AMB} = 29.62 in Hg **T_{AMB}** = 45°F **R.H.** = 86%

NPR = 3.0 **T_T** = 1150°F **V_{J(IDEAL)}** = 2300 FPS

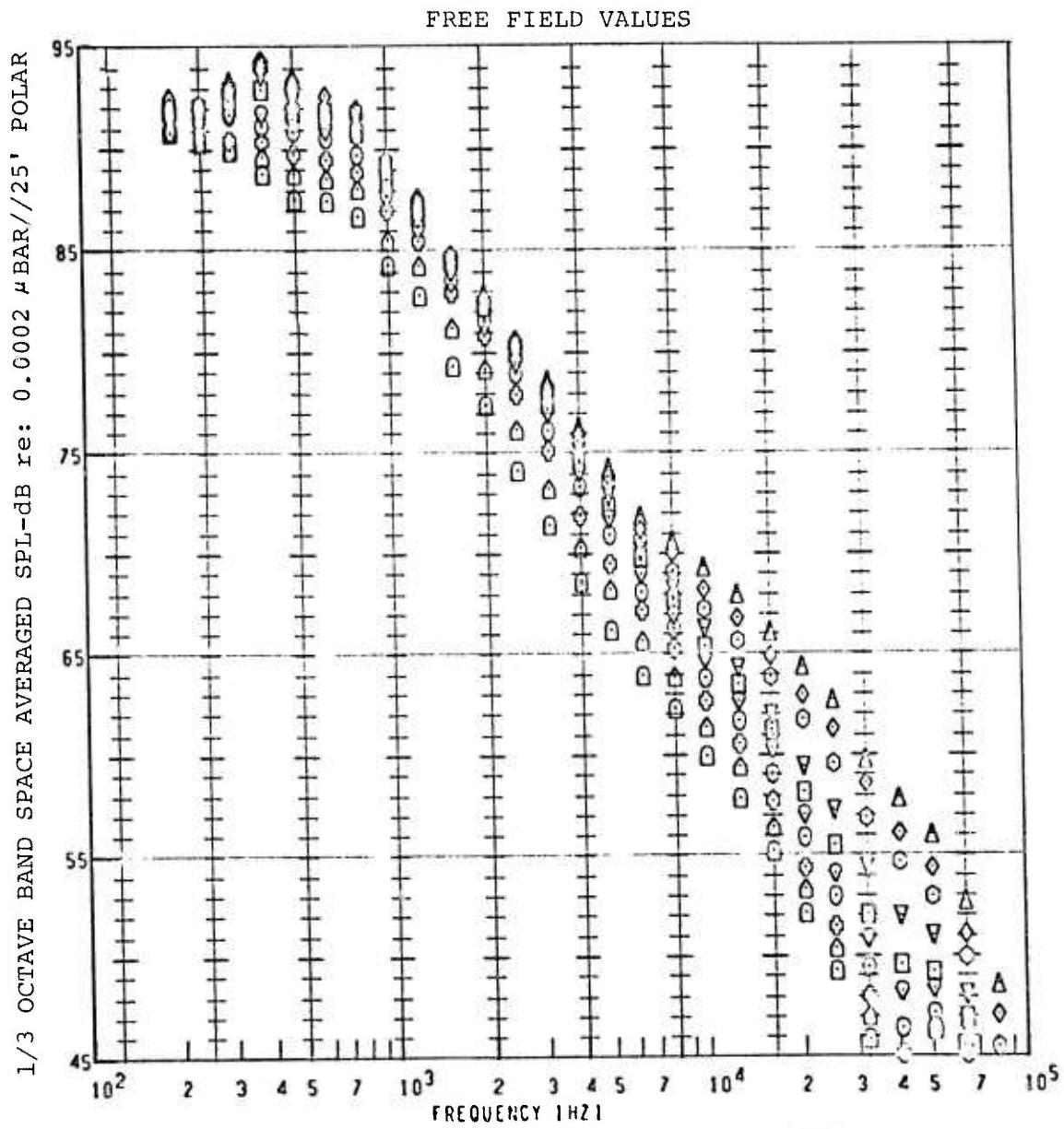
SCALE MODEL A₈ = 13.6 in.²

RUN NO.	AXIAL LOCATION	IRIS DIA.	REMARKS	REF.
251	0.0 x/D	9.4 in.		
254	0.25	9.6		
257	0.50	9.8		
260	0.75	10.0		
263	1.00	10.4		
266	1.25	10.6		
269	1.50	10.8		
272	1.75	11.2		
275	2.0	11.6		
278	2.5	12.0		
281	3.0	12.4		
284	3.5	13.2		
287	4.0	13.6		
290	5.0	14.4		
293	6.0	15.6		
296	7.0	16.4		
299	8.0	17.8		
302	10.0	19.8		
305	12.0	22.0		
308	14.0	24.0		

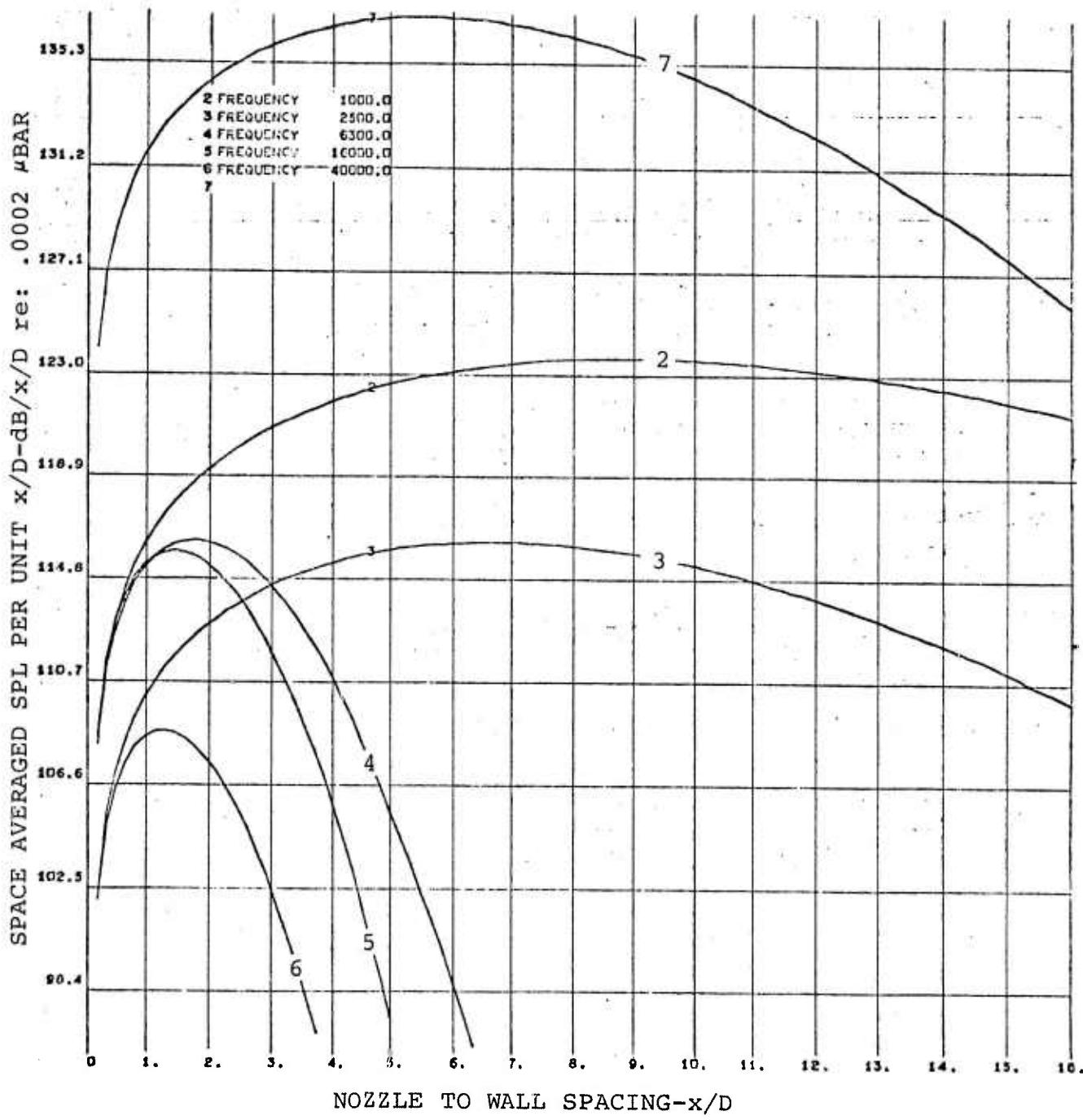
MICROPHONE LAYOUT: 25 FOOT VERTICAL POLAR ARC

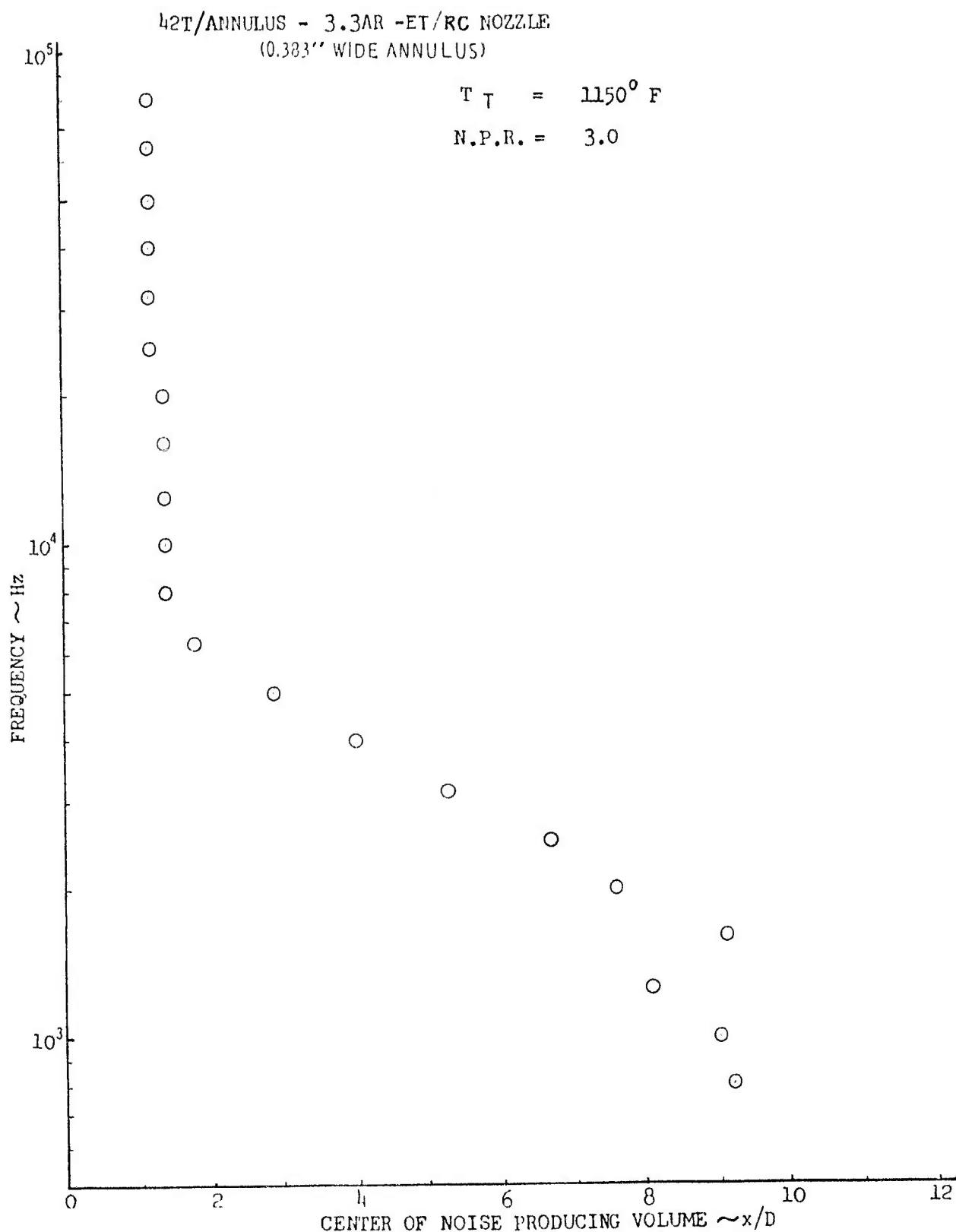


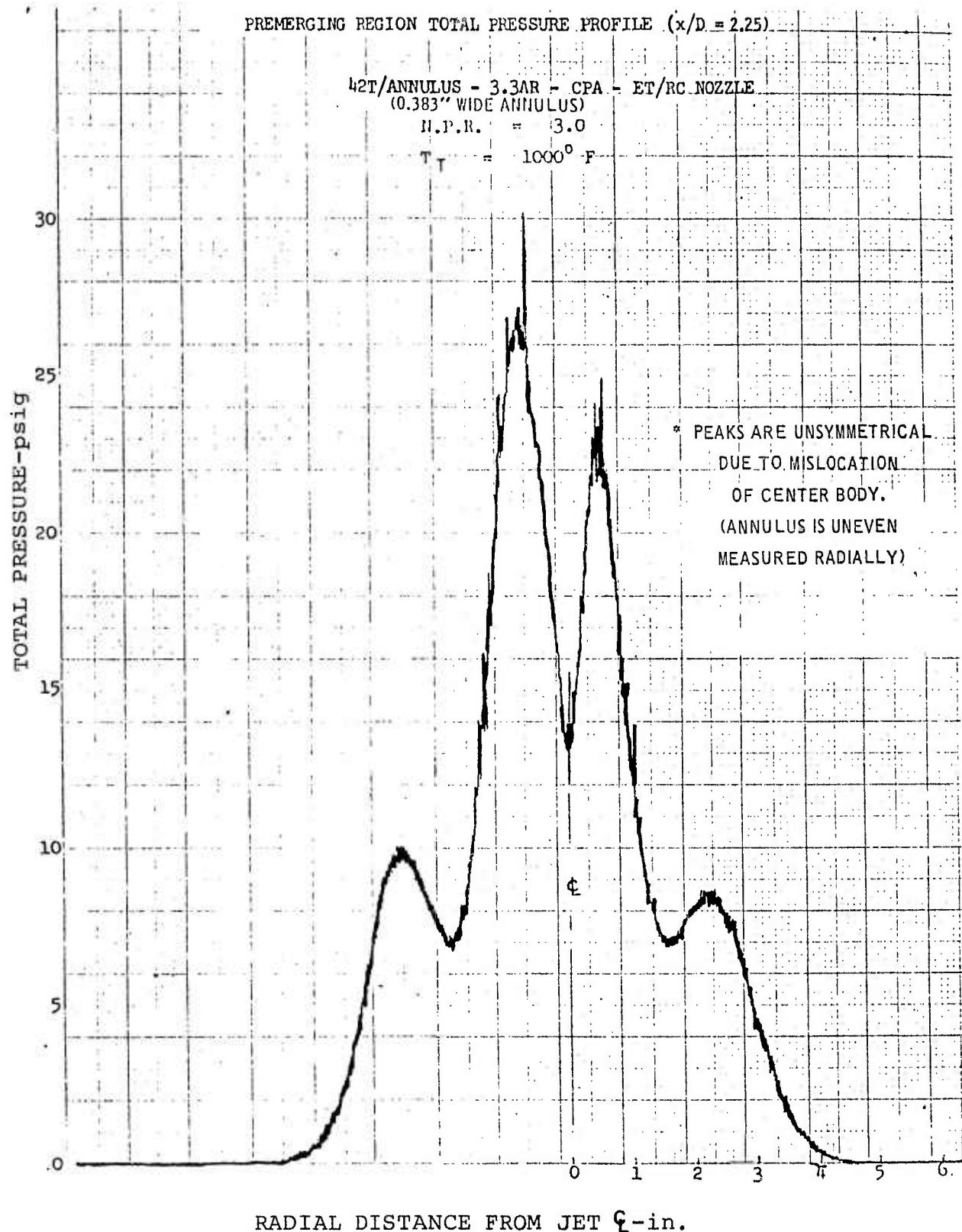
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP	AXIAL LOCATION, x/D
△	251	3.00	1150°F	0
◊	254	3.00	1150	.25
○	257	3.00	1150	.50
○	260	3.00	1150	.75
▽	263	3.00	1150	1.0
□	266	3.00	1150	1.2
○	269	3.00	1150	1.5
○	272	3.00	1150	1.7
○	275	3.00	1150	2.0
○	278	3.00	1150	2.5



PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP	AXIAL LOCATION, x/D
▲	281	3.00	1150°F	3.0
◆	284	3.00	1150	3.5
○	287	3.00	1150	4.0
○	290	3.00	1150	5.0
○	293	3.00	1150	6.0
○	296	3.00	115°	7.0
○	299	3.00	11	8.0
○	302	3.00	1150	10.0
○	305	3.00	1150	12.0
○	308	3.00	1150	14





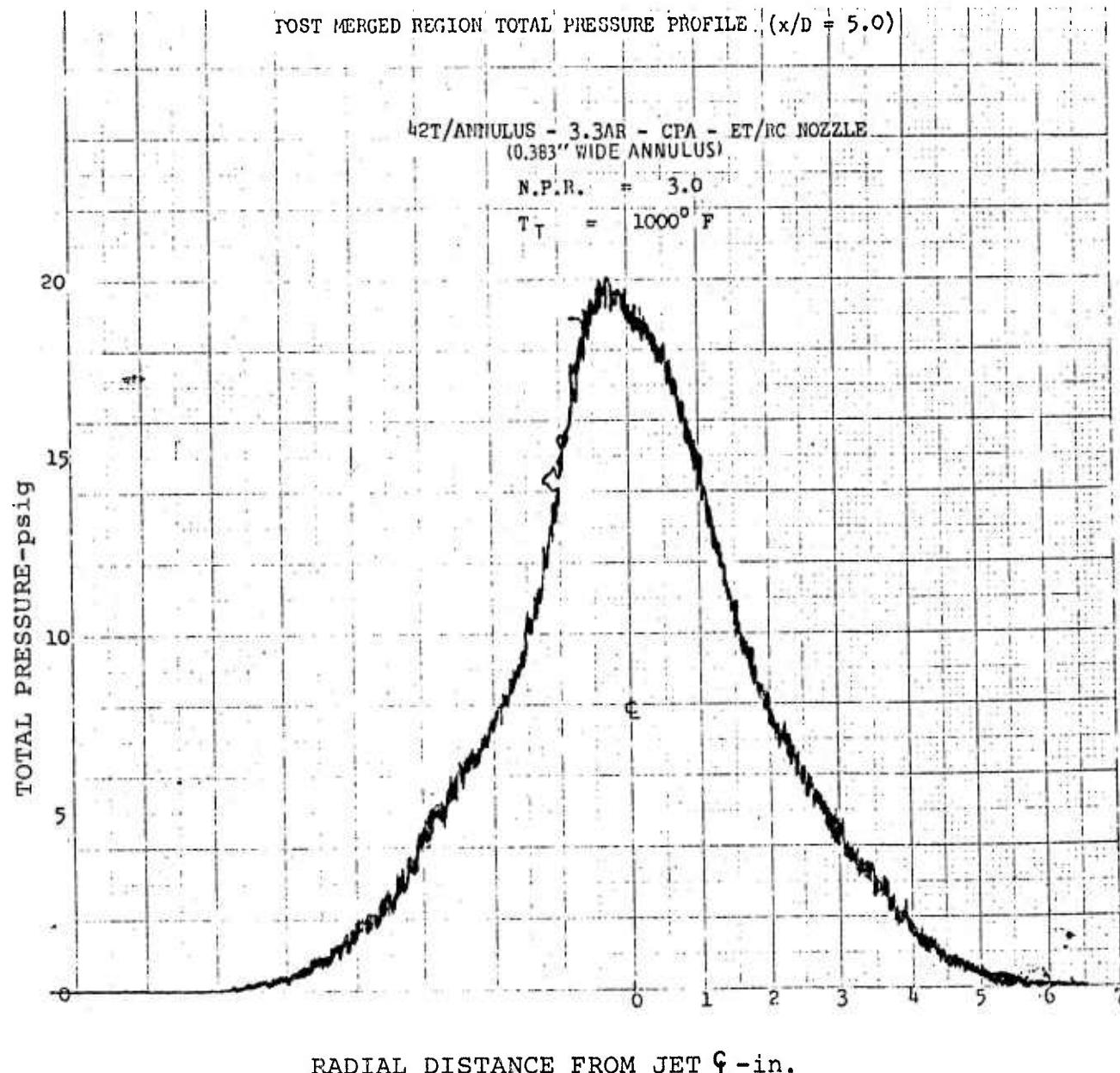


POST MERGED REGION TOTAL PRESSURE PROFILE (x/D = 5.0)

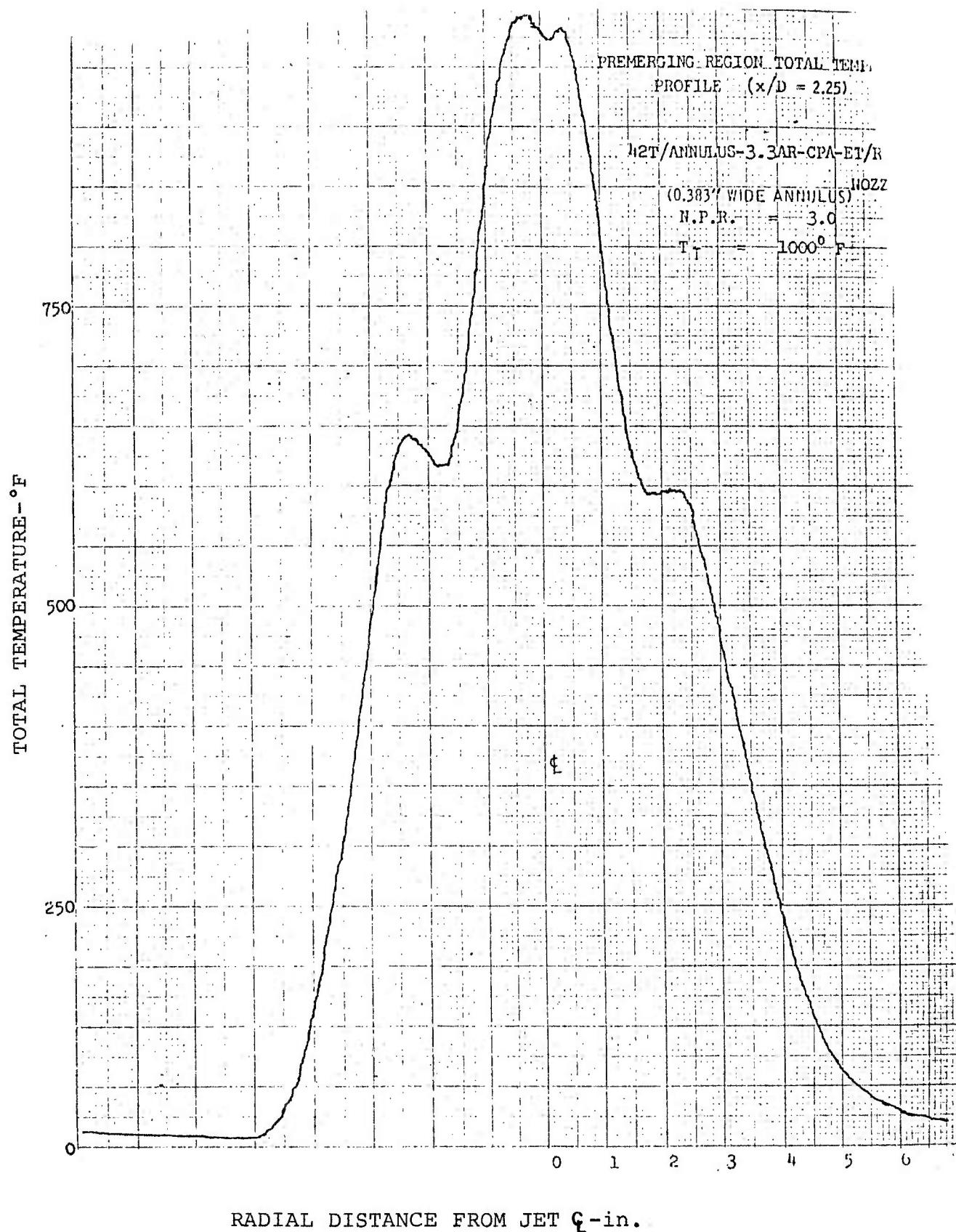
42T/ANNULUS - 3.3AR - CPA - ET/RC NOZZLE
(0.383" WIDE ANNULUS)

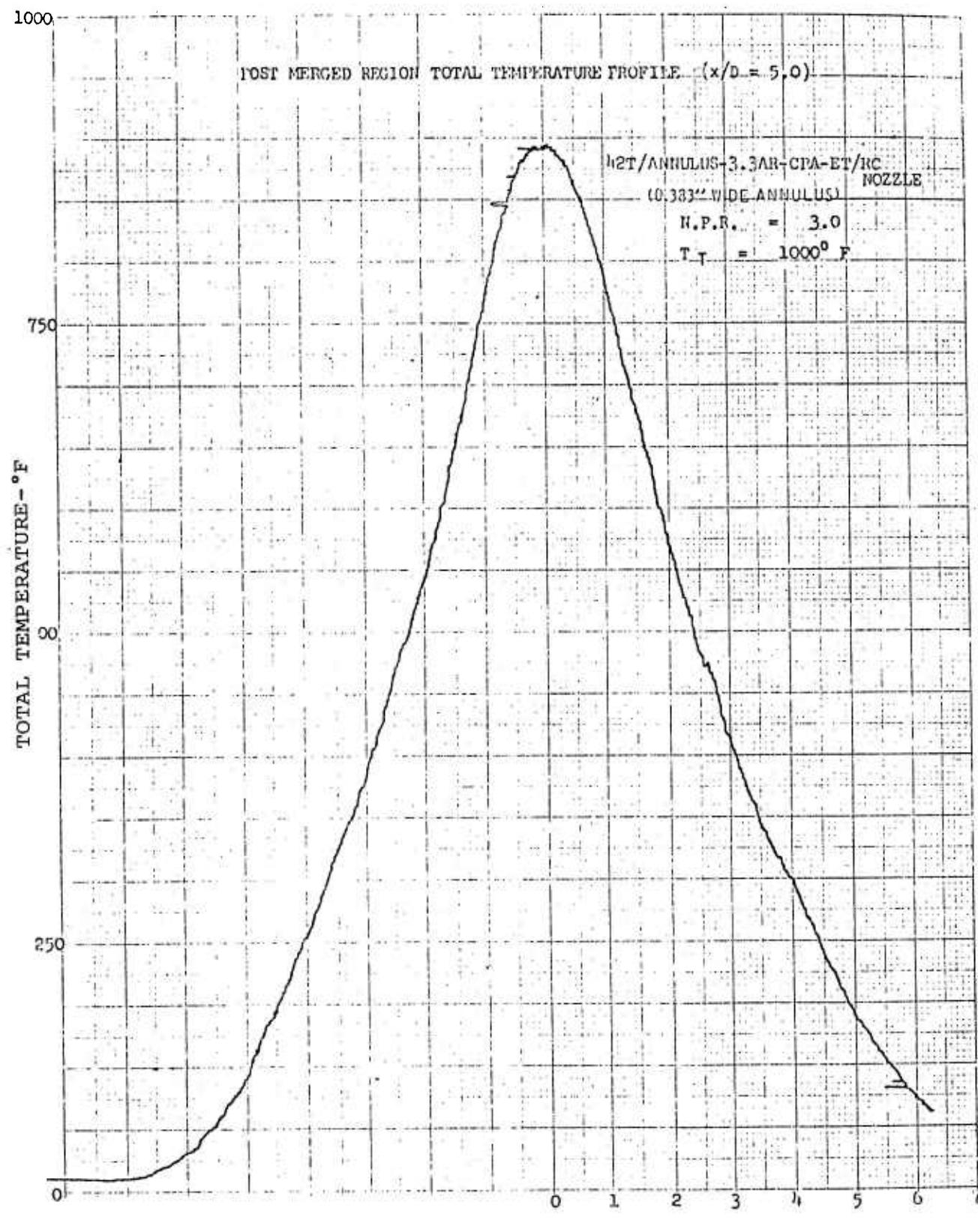
N.P.R. = 3.0

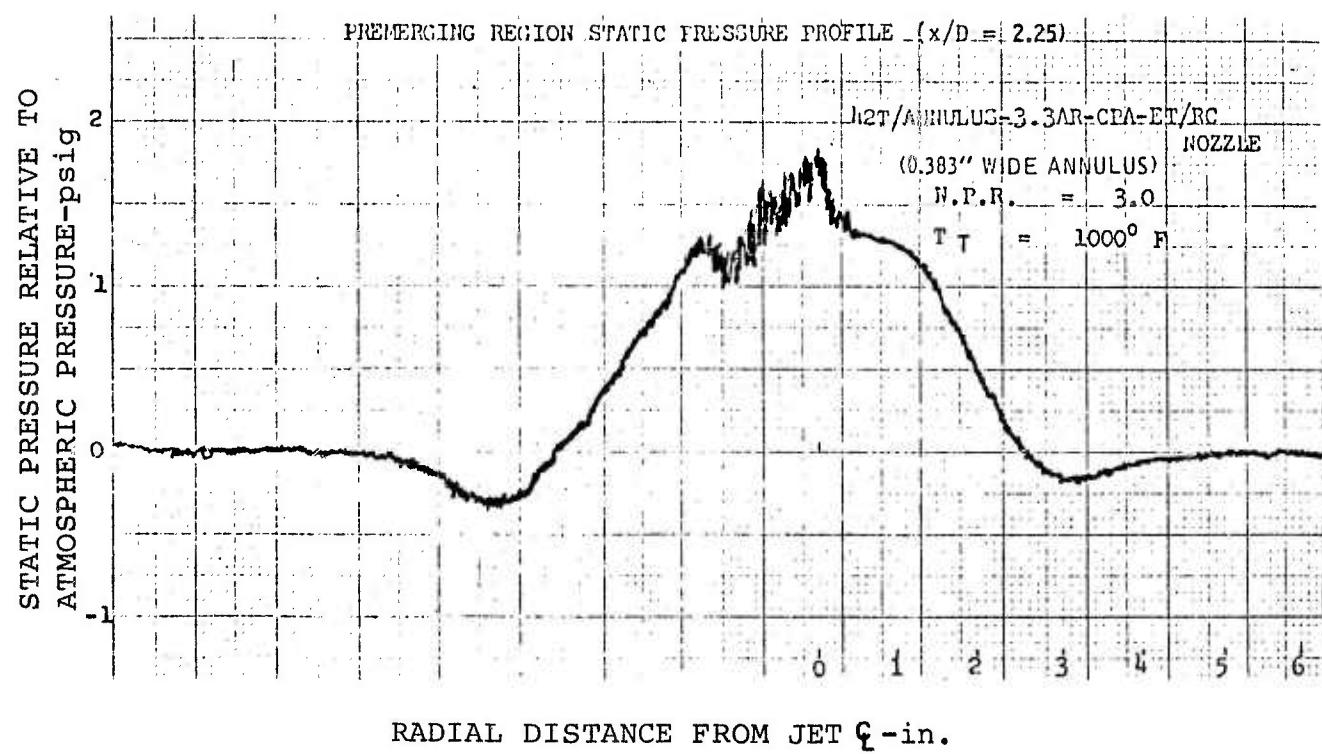
T_T = 1000° F

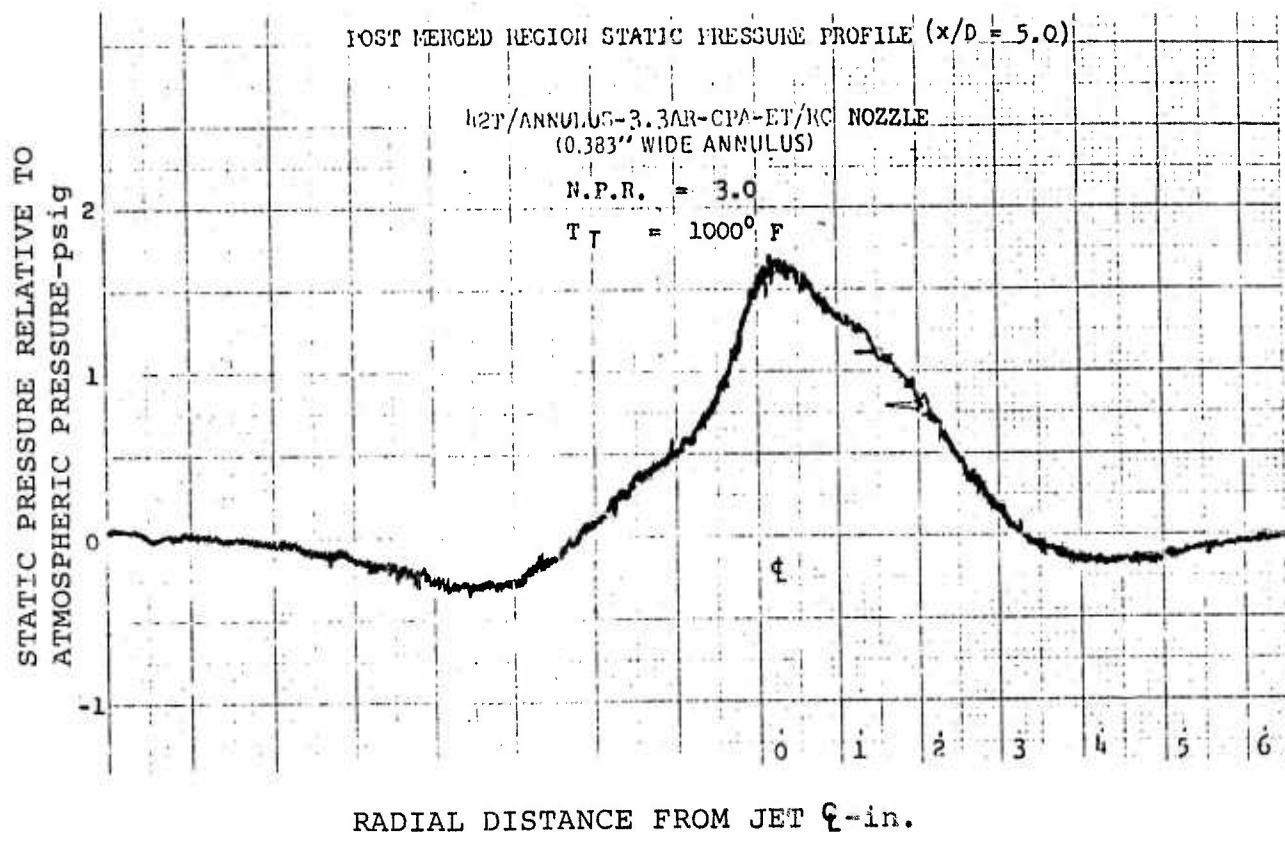


RADIAL DISTANCE FROM JET CENTERLINE - in.









TEST CONDITIONS

NOZZLE: 42T/Annulus-3.0AR-CPA-ET/RC

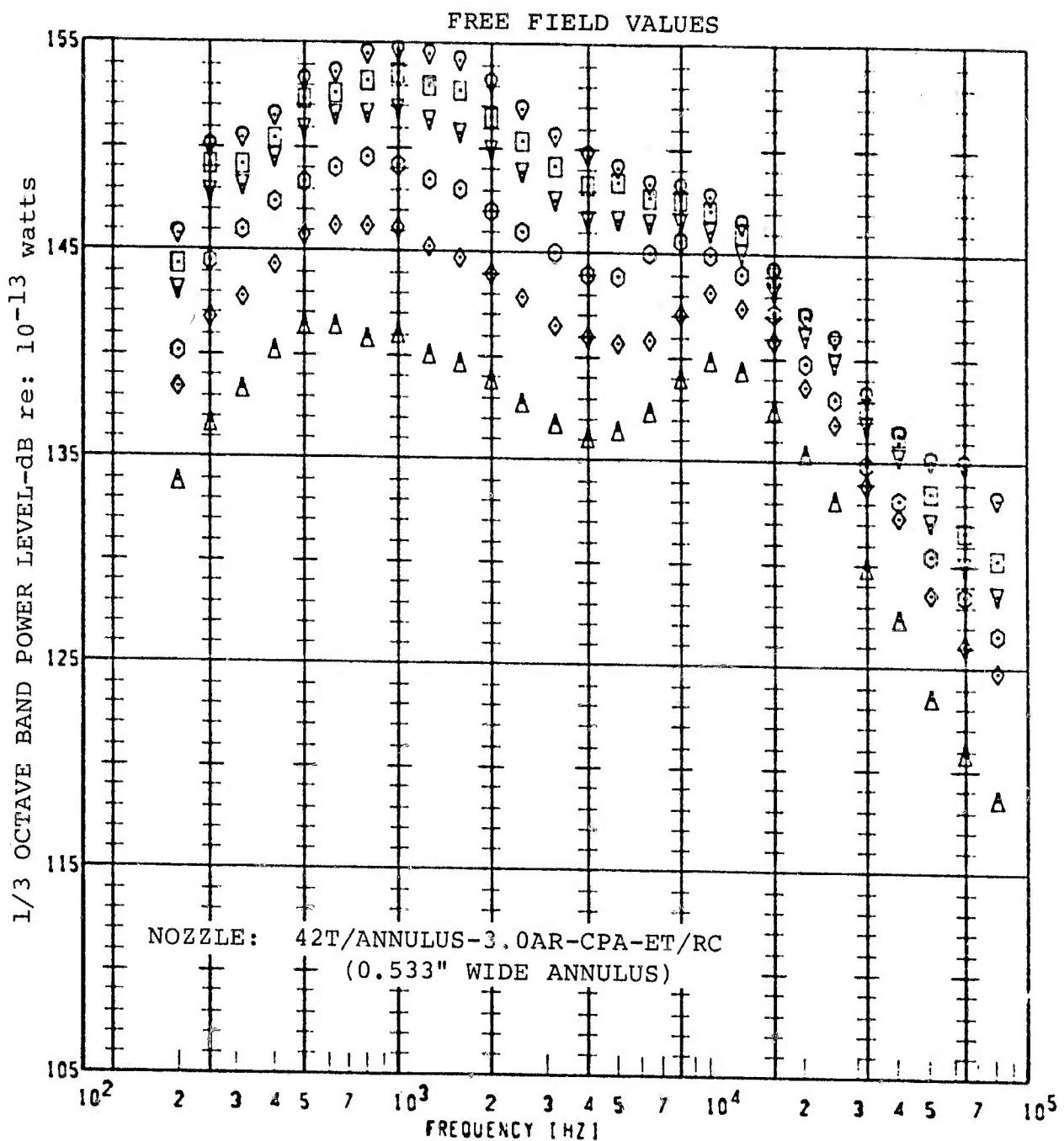
FACILITY: HNTF

DATE: 10-17-73 **T_{AMB}** = 70° F **R.H.** = 52°

SCALE MODEL A₈ = 15.0 in.²

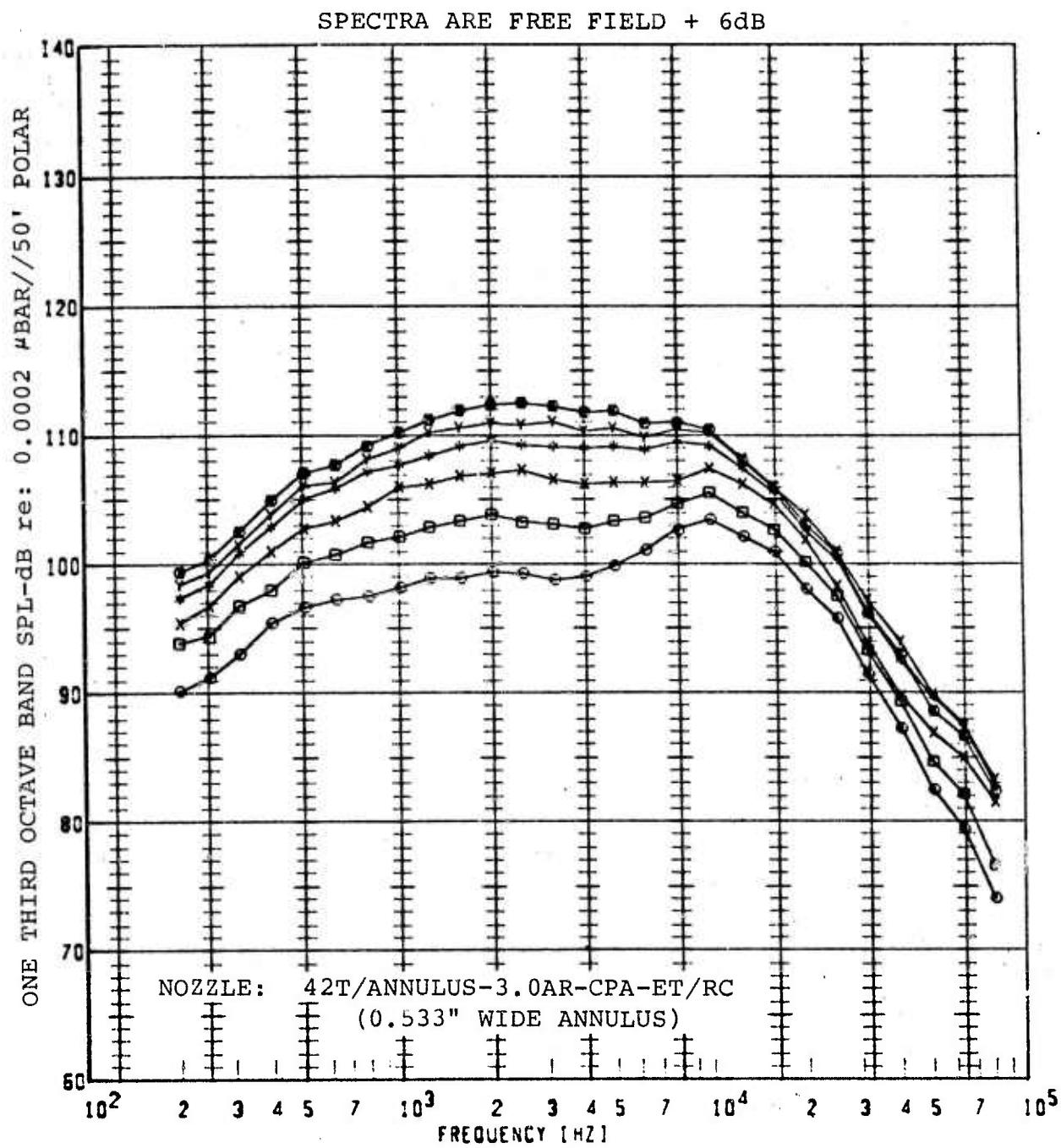
RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
177	2.0	1150° F	1875 fps	Annulus width =	
"	2.5	"	2126	0.533"	
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



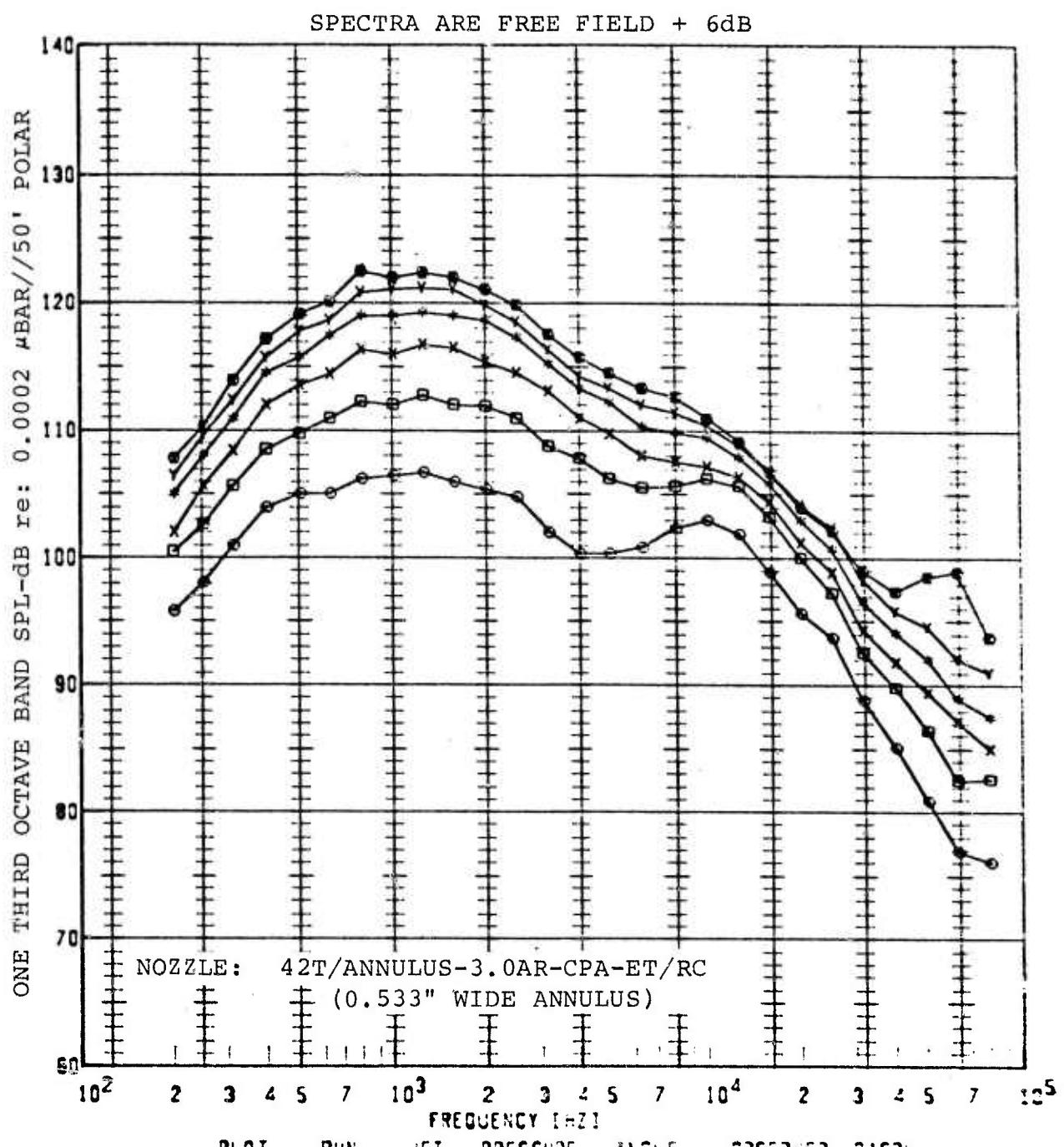
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	177	2.00	1150°F
◊	177	2.50	1150
○	177	3.00	1150
▽	177	3.40	1150
□	177	3.70	1150
◎	177	4.00	1150

JET NOISE POWER SPECTRA



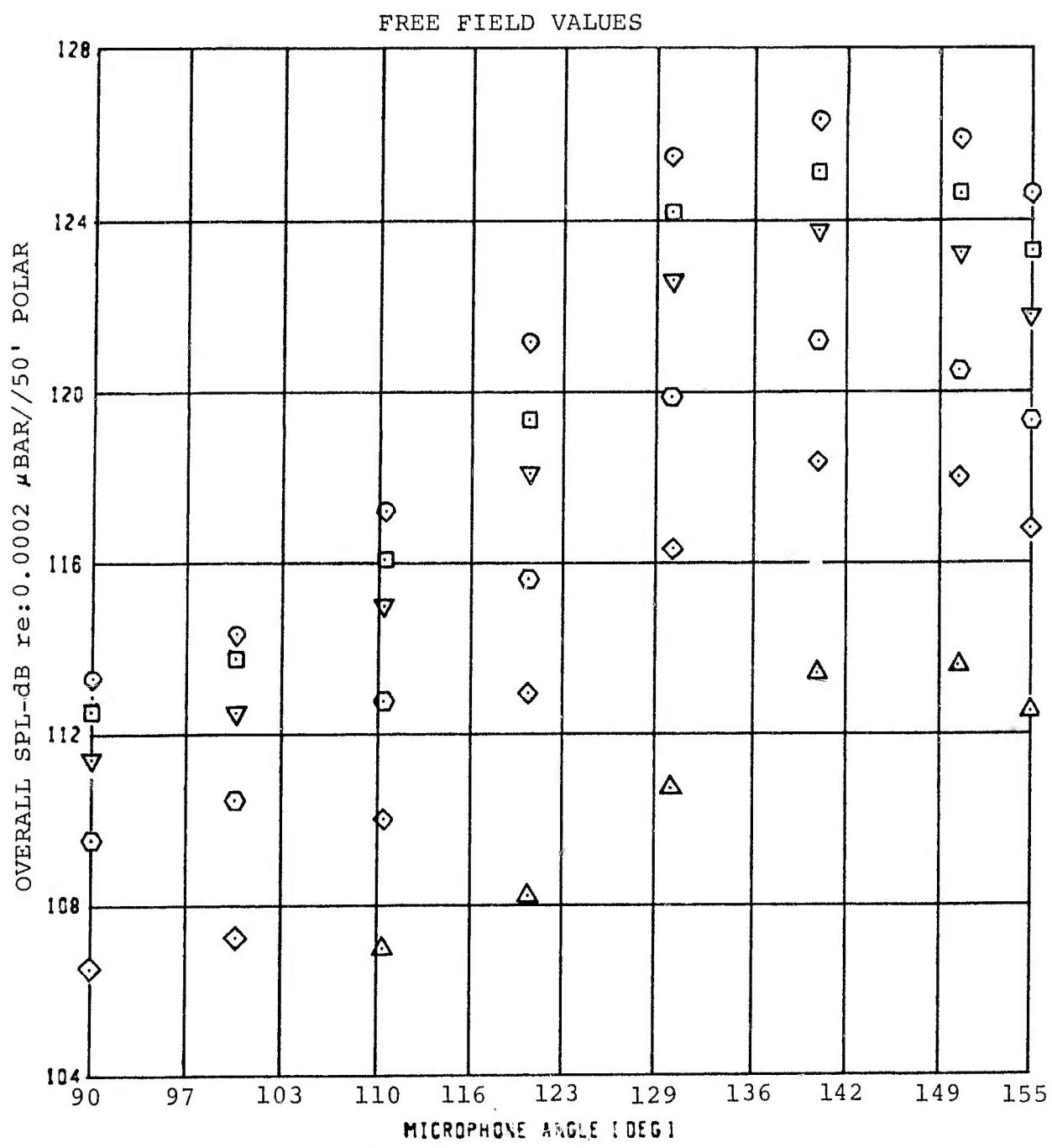
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL [dB]
○	177G	1150°F	2.000	110°	SOFP	112.6
□	177G	1150	2.500		SOFP	115.7
×	177G	1150	3.000		SOFP	118.5
*	177G	1150	3.400		SOFP	120.7
▽	177G	1150	3.700		SOFP	121.9
●	177G	1150	4.000		SOFP	123.0

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



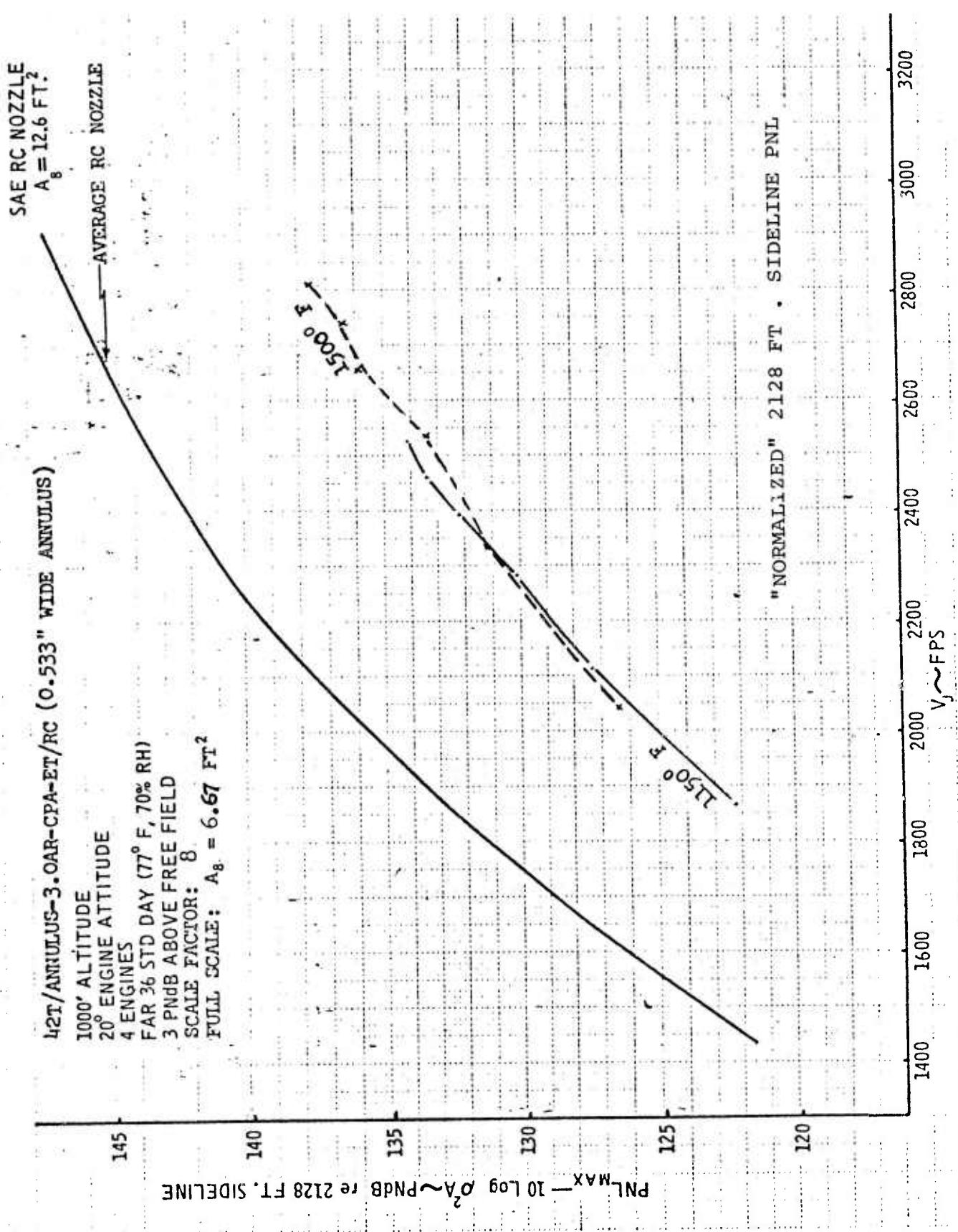
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	CASE
○	1776	1150°F	2.000	130°	SCFP	116.7
□	1776	1150	2.500		SCFP	122.2
×	1776	1150	3.000		SCFP	125.9
*	1776	1150	3.400		SCFP	128.5
Y	1776	1150	3.700		SCFP	130.1
●	1776	1150	4.000		SCFP	131.4

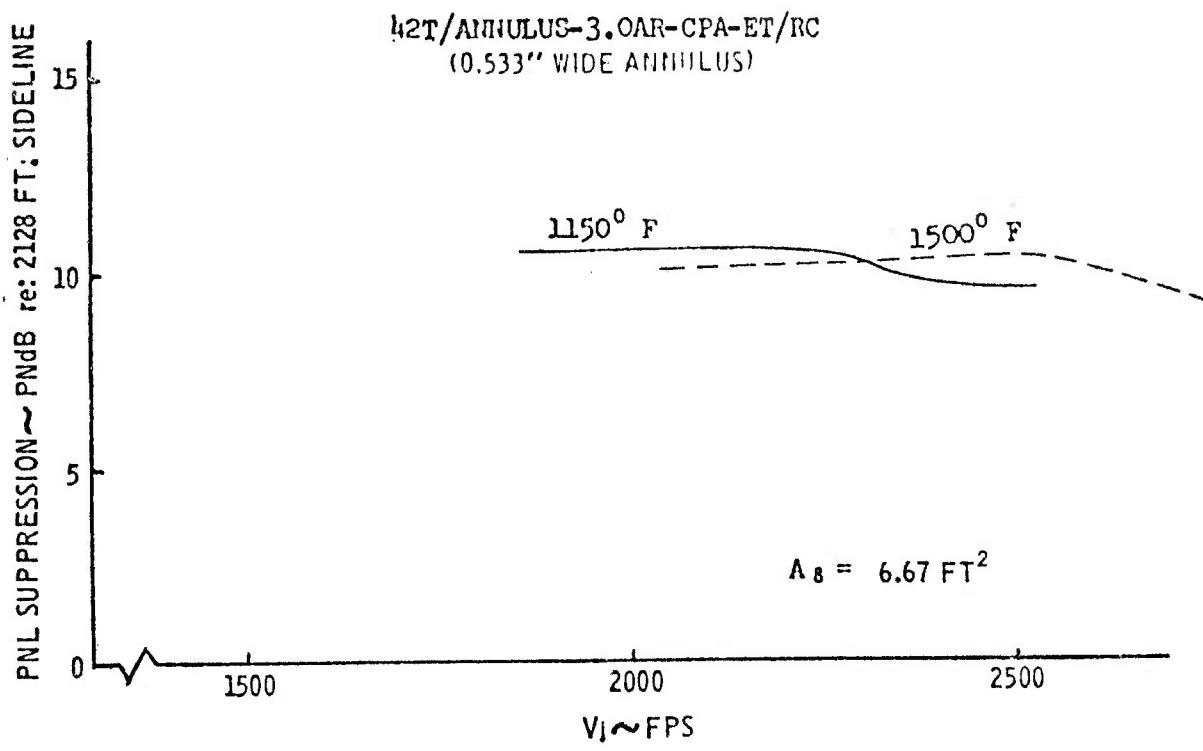
MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



NOZZLE: 42T/ANNULUS-3.0AR-CPA-ET/RC
(0.533" WIDE ANNULUS)

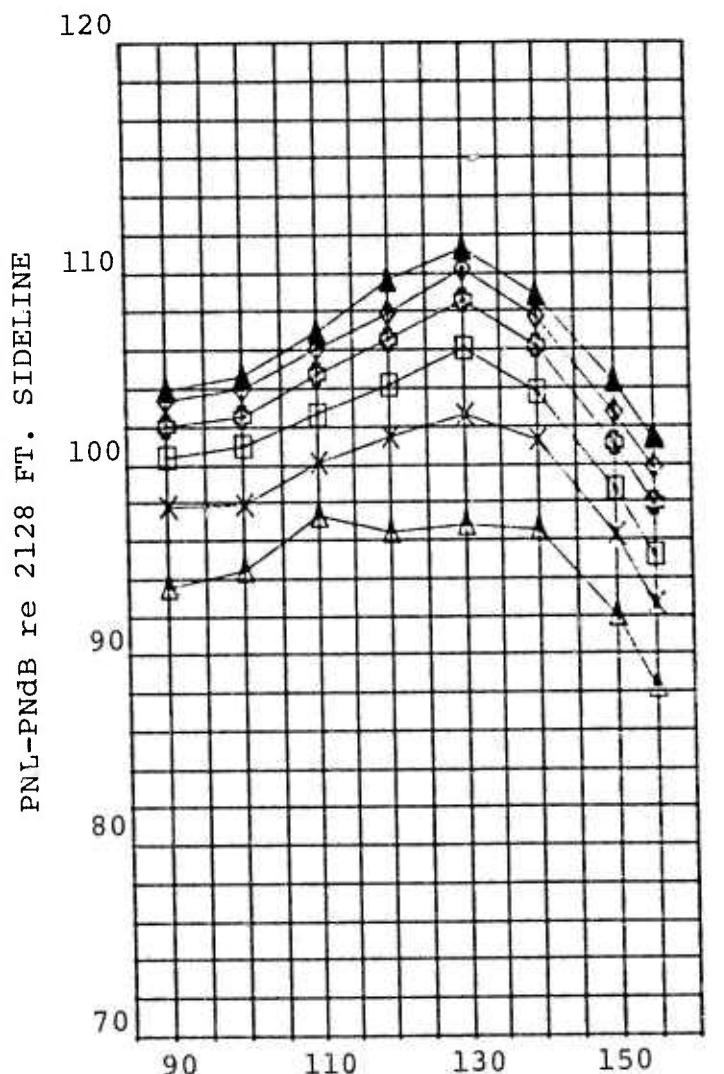
OASPL BEAM PATTERNS





PEAK PNL SUPPRESSION VALUES

NOZZLE: 42T/ANNULUS-3.0AR-CPA-ET/RC
(0.533" WIDE ANNULUS)



DIRECTIVITY ANGLE-DEGREES

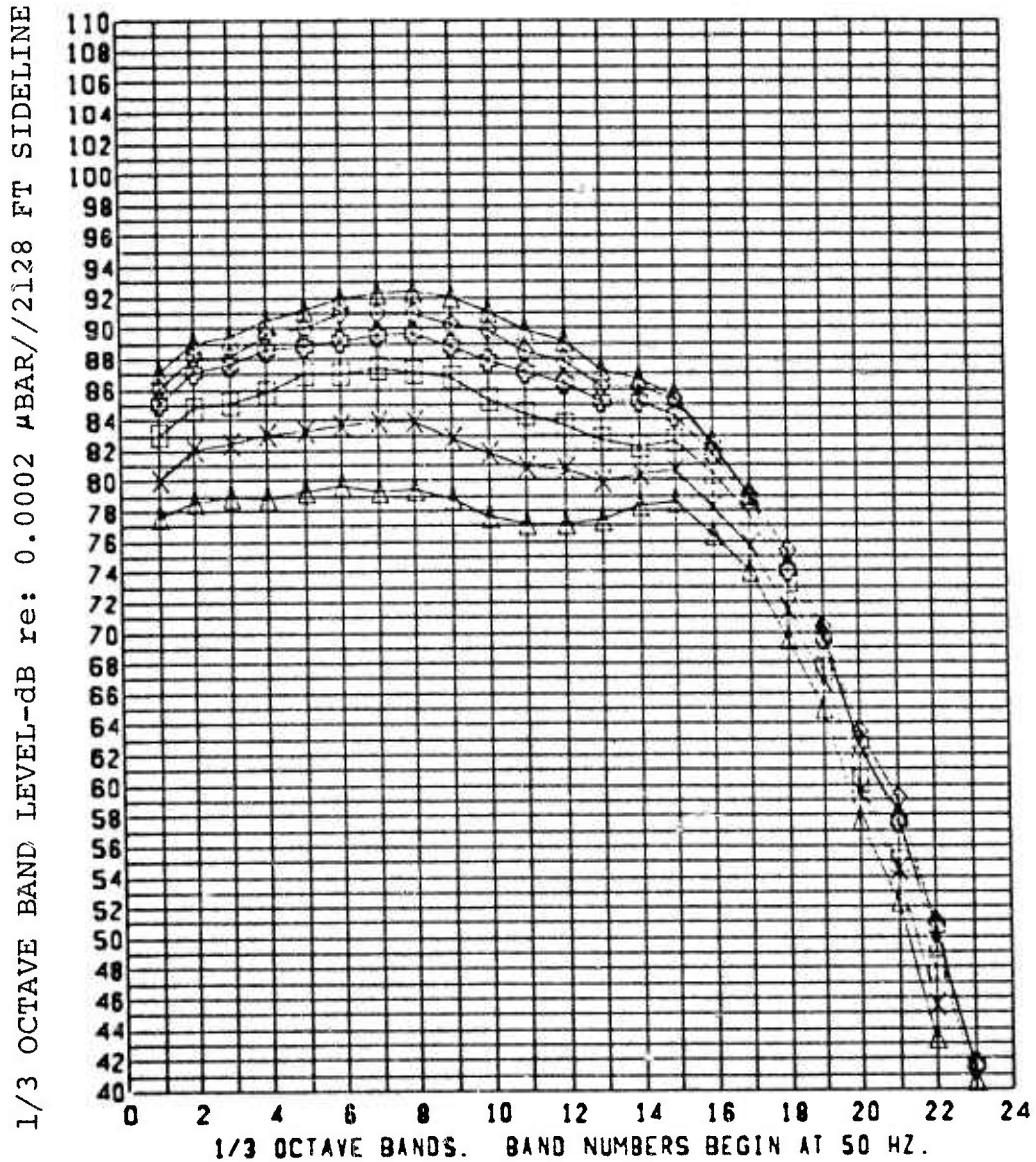
PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 3.4, \diamond 3.7, \blacktriangle 4.0

TT = 1150°F A8 = 6.67 FT² RUN: 177

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.67 FT² RUN: 177

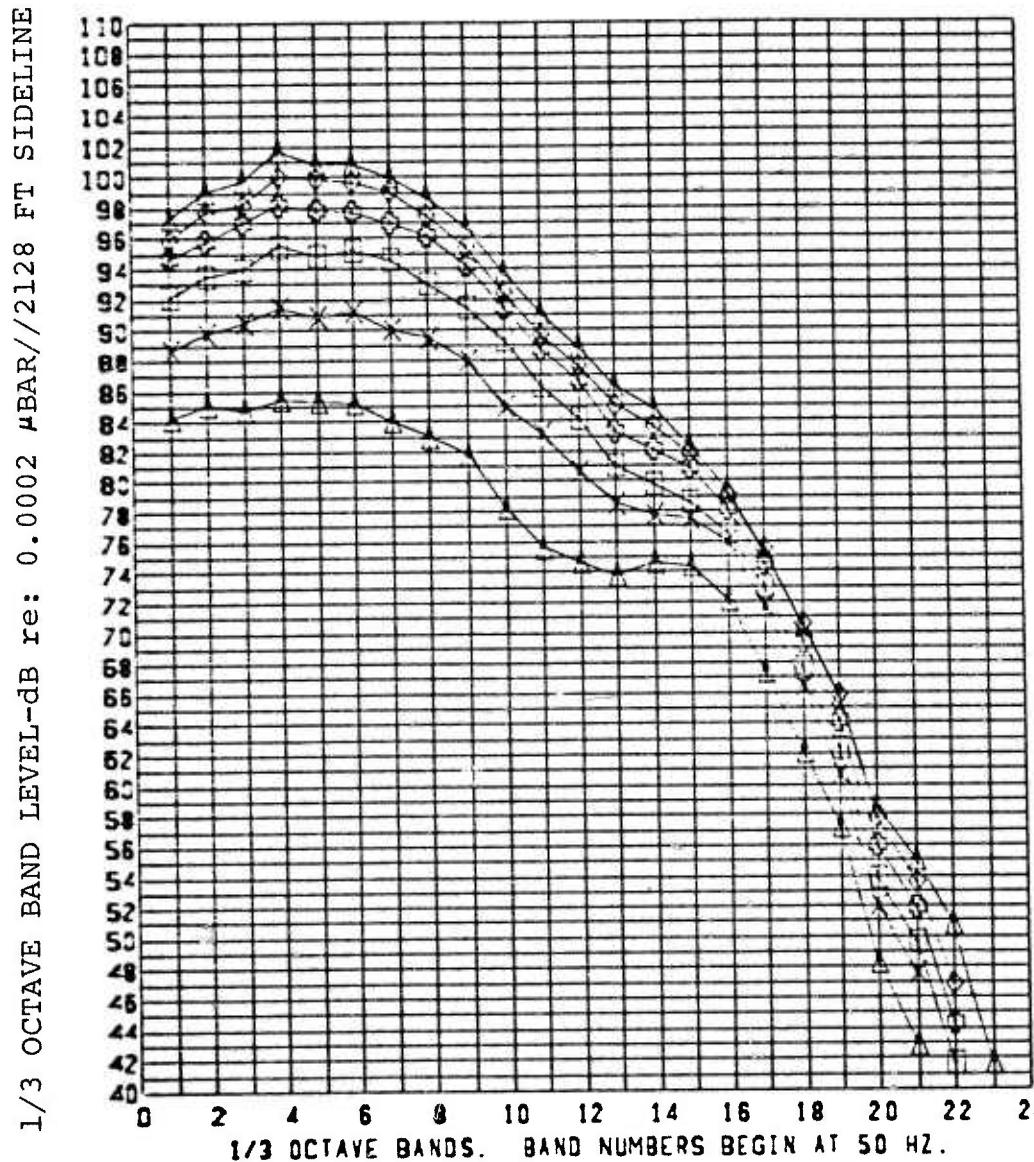
PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.4, \diamond 3.7, \blacktriangle 4.0

NOZZLE: 42T/ANNULUS-3.0AR-CPA-ET/RC
(0.533" WIDE ANNULUS)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 6.67 FT² RUN: 177

PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.4, \diamond 3.7, \blacktriangle 4.0

NOZZLE: 42T/ANNULUS-3.0AR-CPA-ET/RC
(0.533" WIDE ANNULUS)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°

re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 42T/Annulus-2.6AR-CPA-ET/RC

FACILITY: HNTF

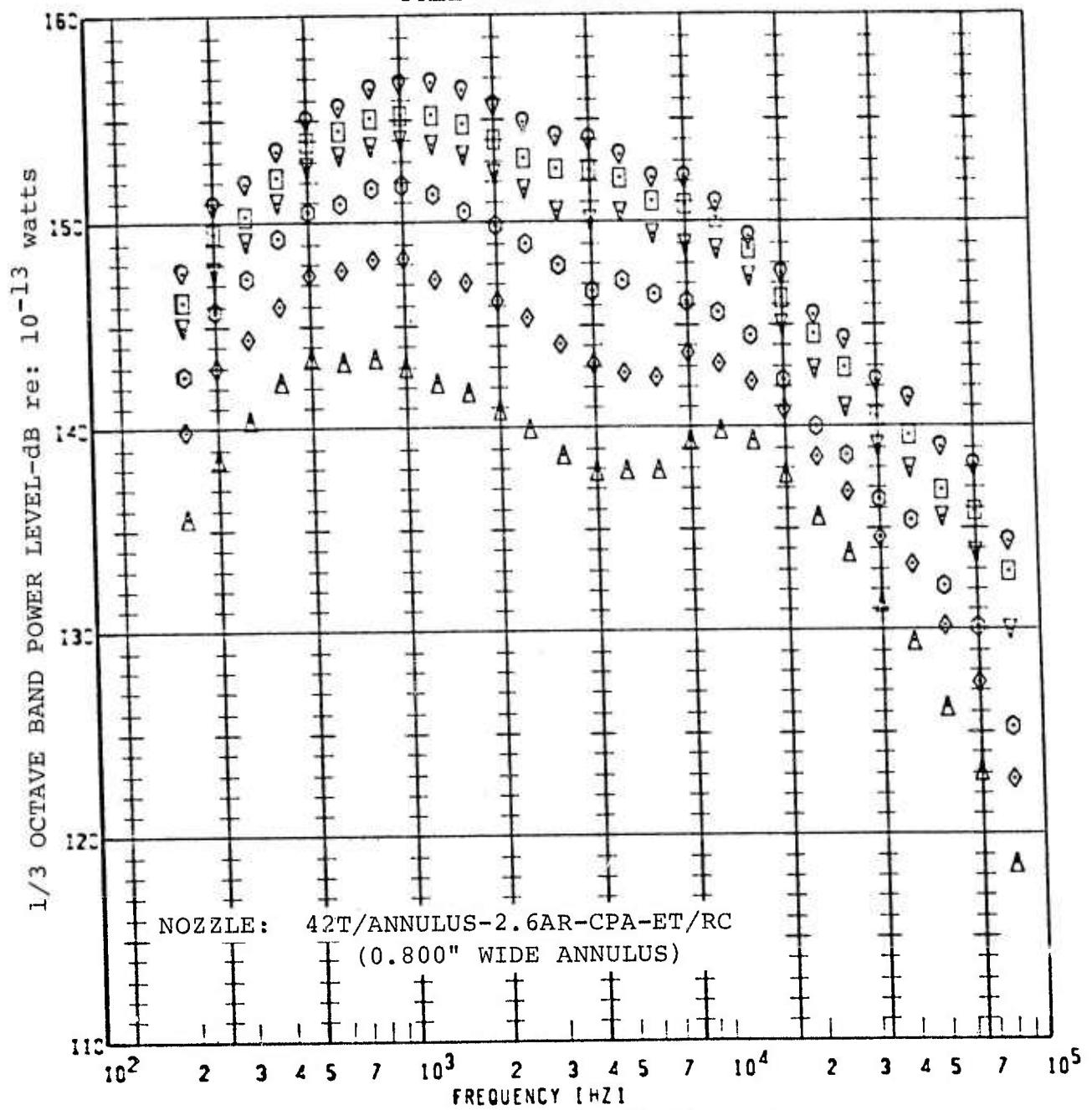
DATE: 10-17-73 **T_{AMB}** = 55°F **R.H.** = 77%

SCALE MODEL A₈ = 17.2 in.²

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
175	2.0	1150°F	1875 fps	Annulus width =	
"	2.5	"	2126	0.8"	
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

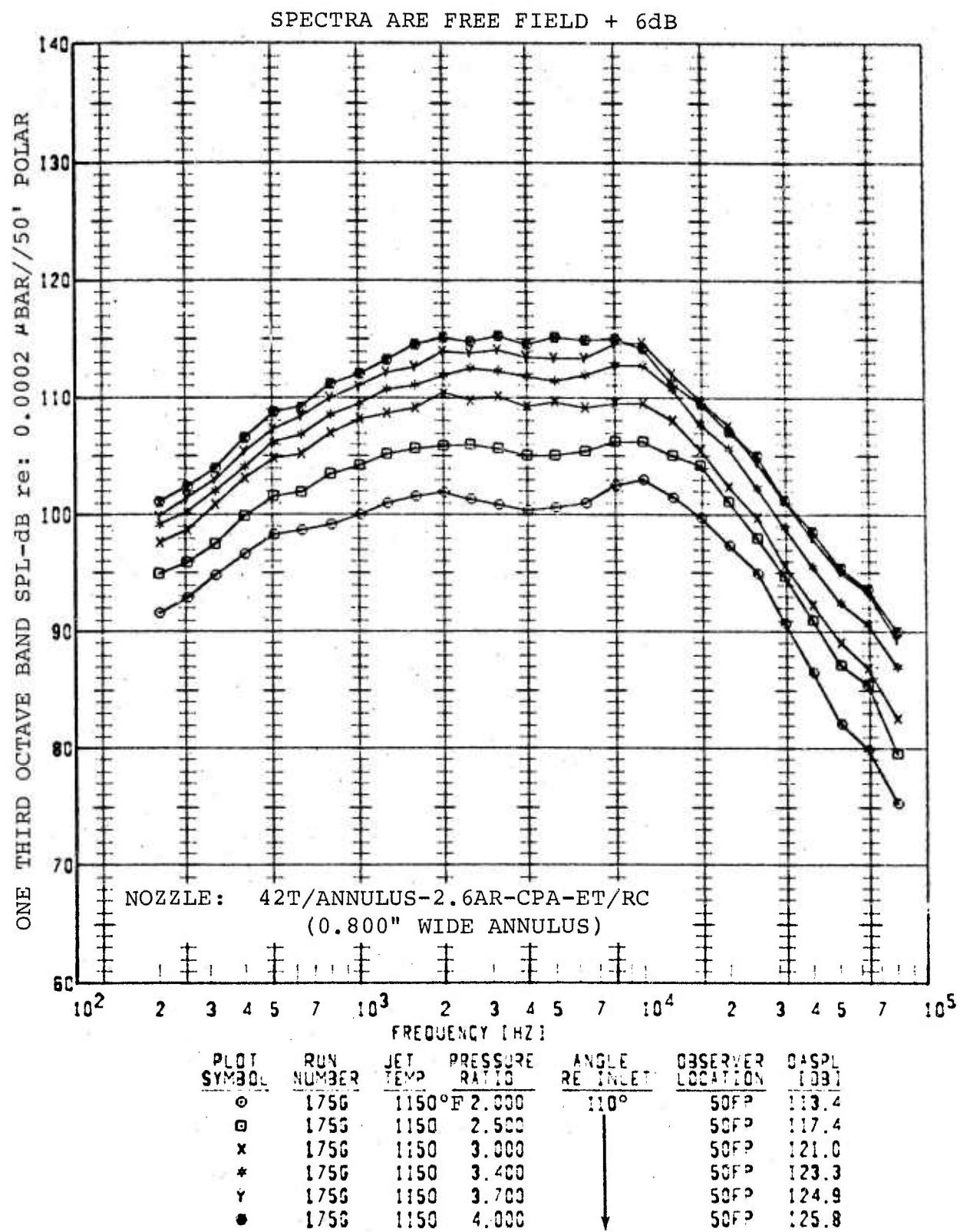
MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

FREE FIELD VALUES



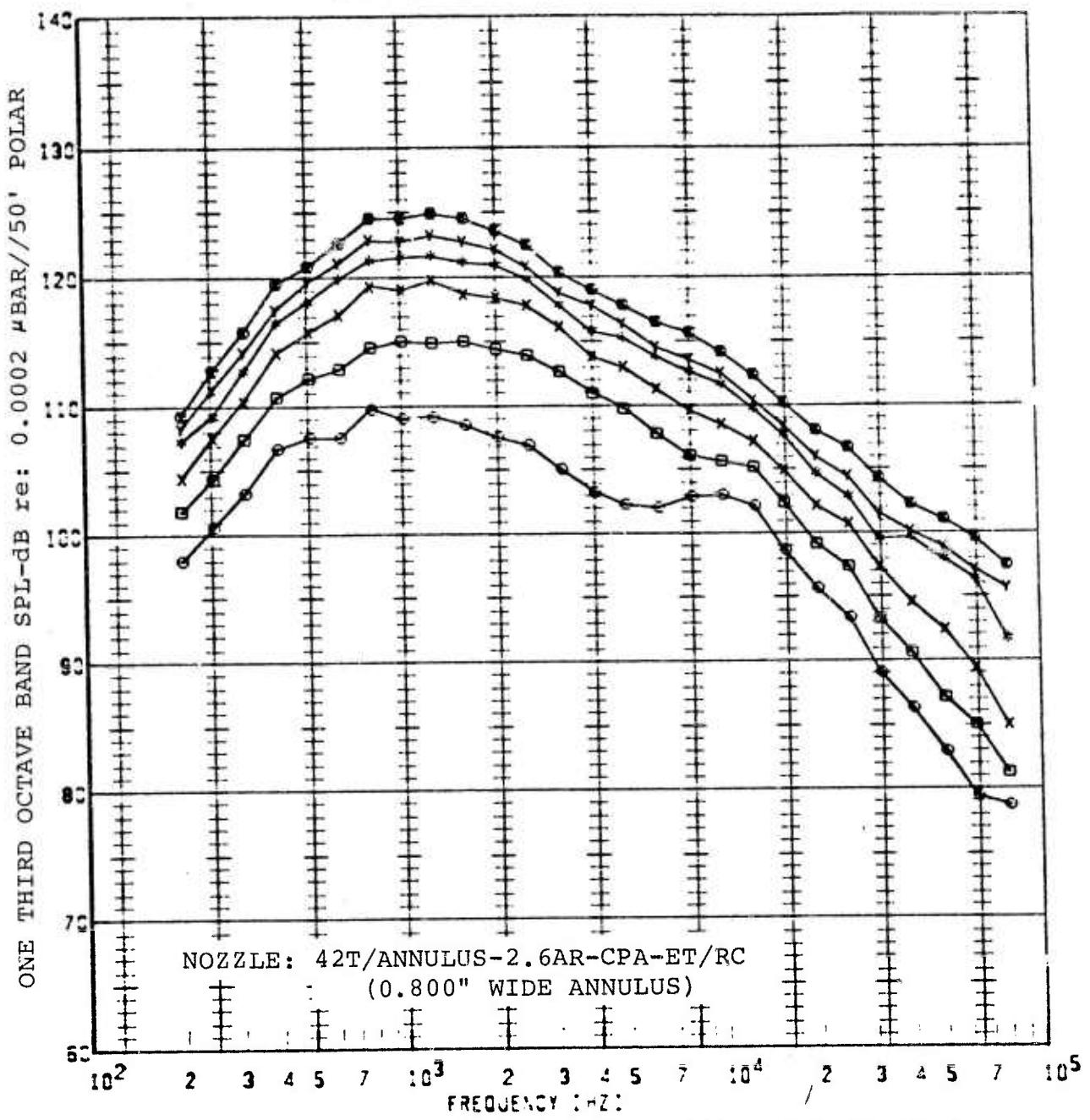
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	175	2.00	1150°F
◊	175	2.50	1150
○	175	3.00	1150
▽	175	3.40	1150
□	175	3.70	1150
◊	175	4.00	1150

JET NOISE POWER SPECTRA



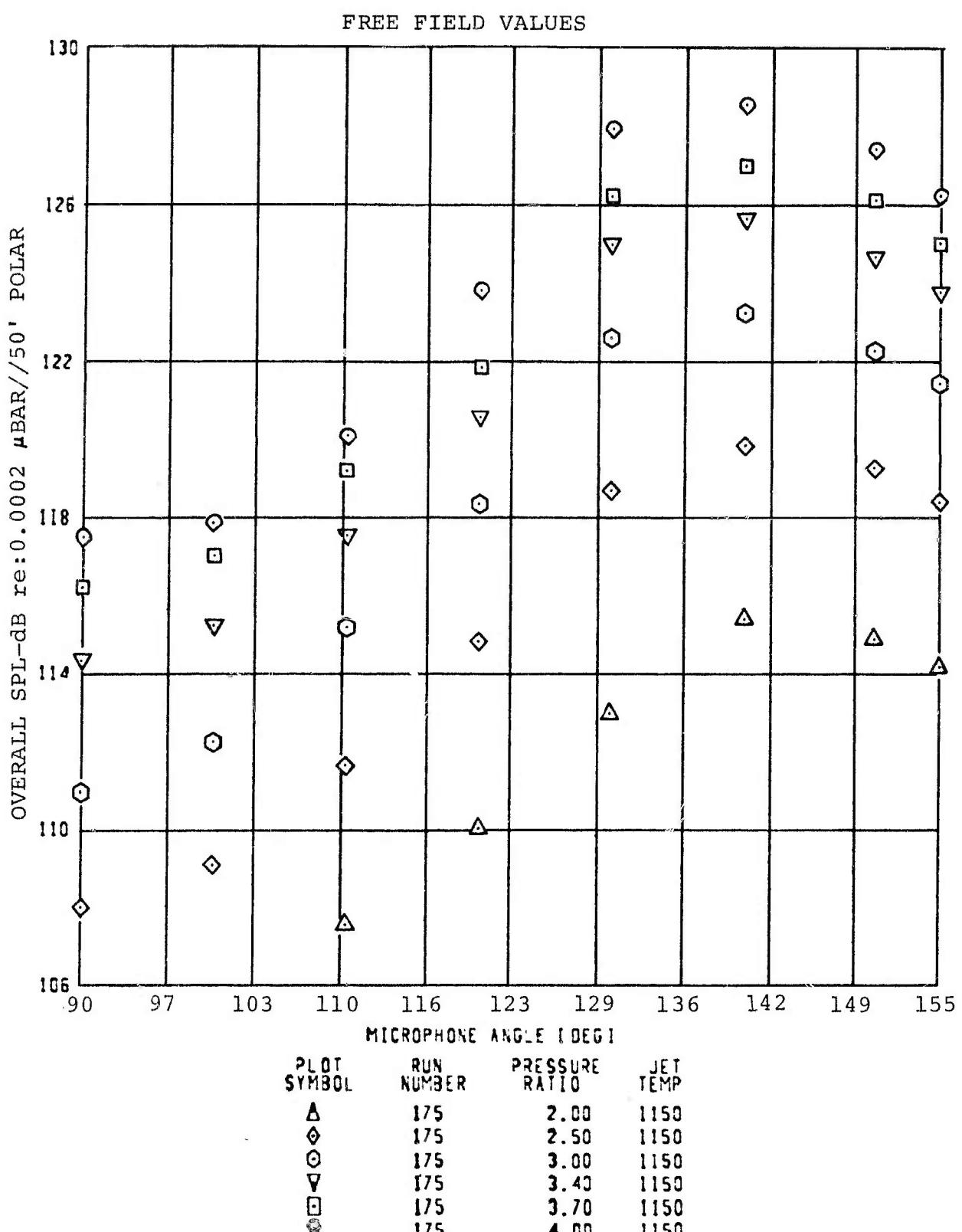
MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS

SPECTRA ARE FREE FIELD + 6dB



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RE 130°	ANGLE REL. INLET	OBSERVER LOCATION	DASPL
○	1750	1150°F	2.000	130°	SCFP	119.0
□	1750	1150	2.500		SCFP	124.7
x	1750	1150	3.000		SCFP	128.6
*	1750	1150	3.400		SCFP	130.9
†	1750	1150	3.700		SCFP	132.2
●	1750	1150	4.000		SCFP	133.8

MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



OASPL BEAM PATTERNS

SAE RC NOZZLE
 $A_0 = 12.6 \text{ FT}^2$

42T/ANRULUS--2.6AR-CPA-ET/RC (0.800" WIDE ANTRULUS)

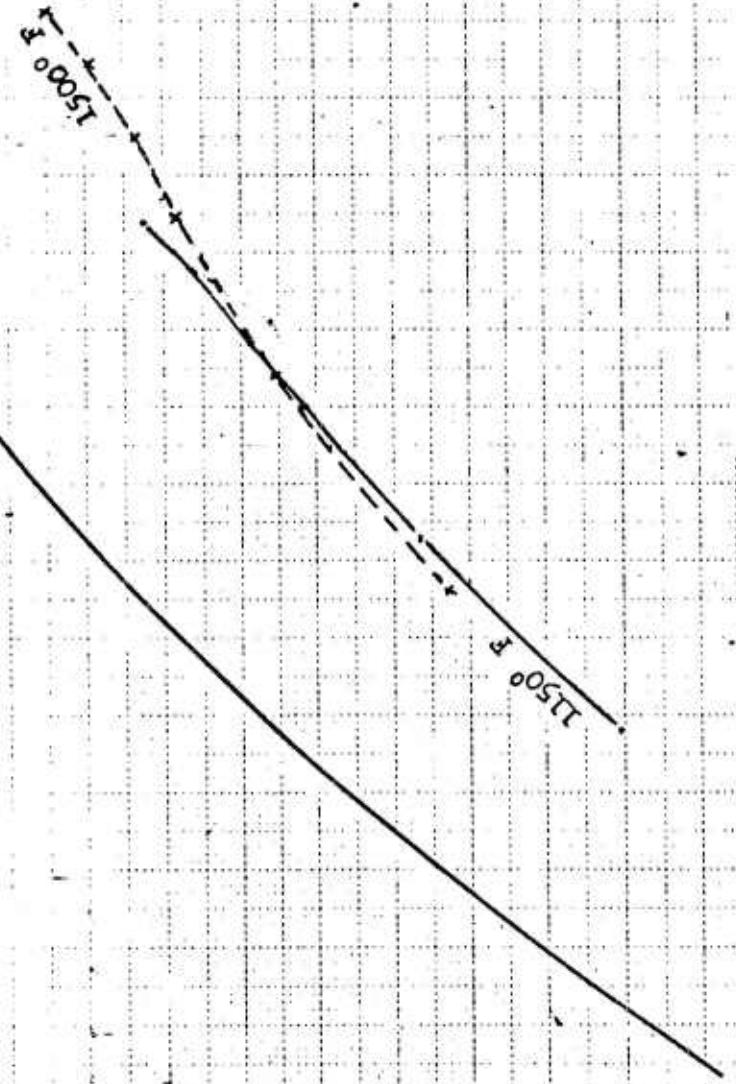
1000' ALTITUDE
20° ENGINE ATTITUDE

4 ENGINES
FAR 36 STD DAY (77° F, 70% RH)

3 PNDB ABOVE FREE FIELD
SCALE FACTOR: 8
FULL SCALE: $A_0 = 7.63 \text{ FT}^2$

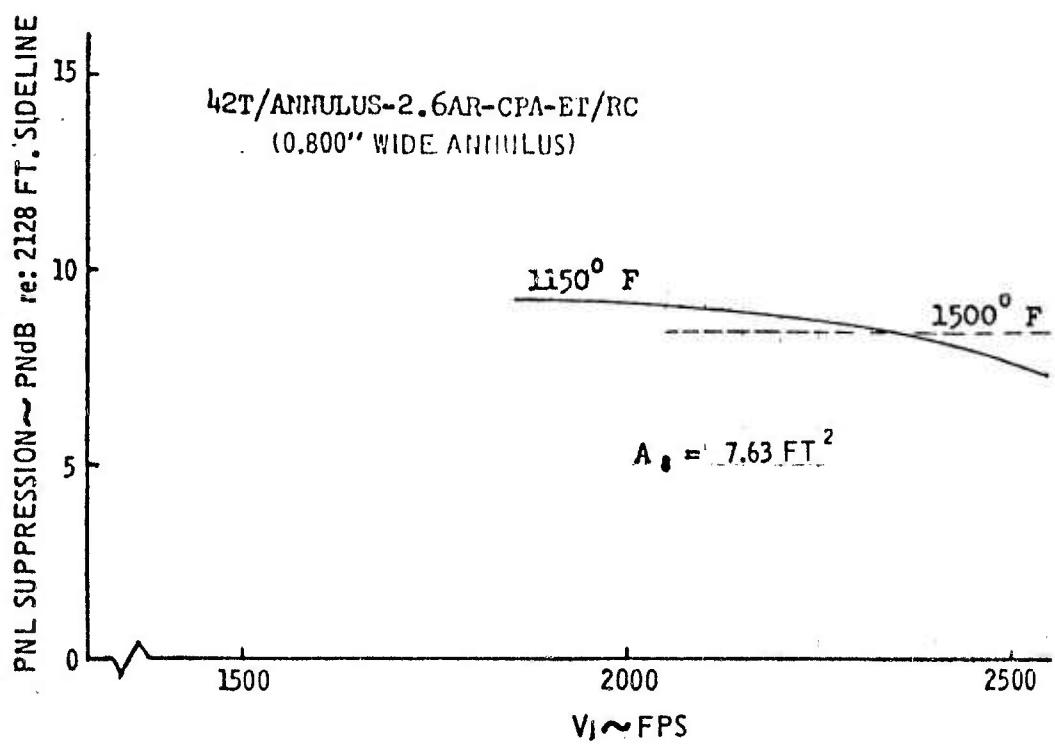
AVERAGE RC NOZZLE

$$PNL_{MAX} - 10 \log \frac{Q}{Q_{PNDB}} \text{ re } 2128 \text{ FT. SIDELINE}$$



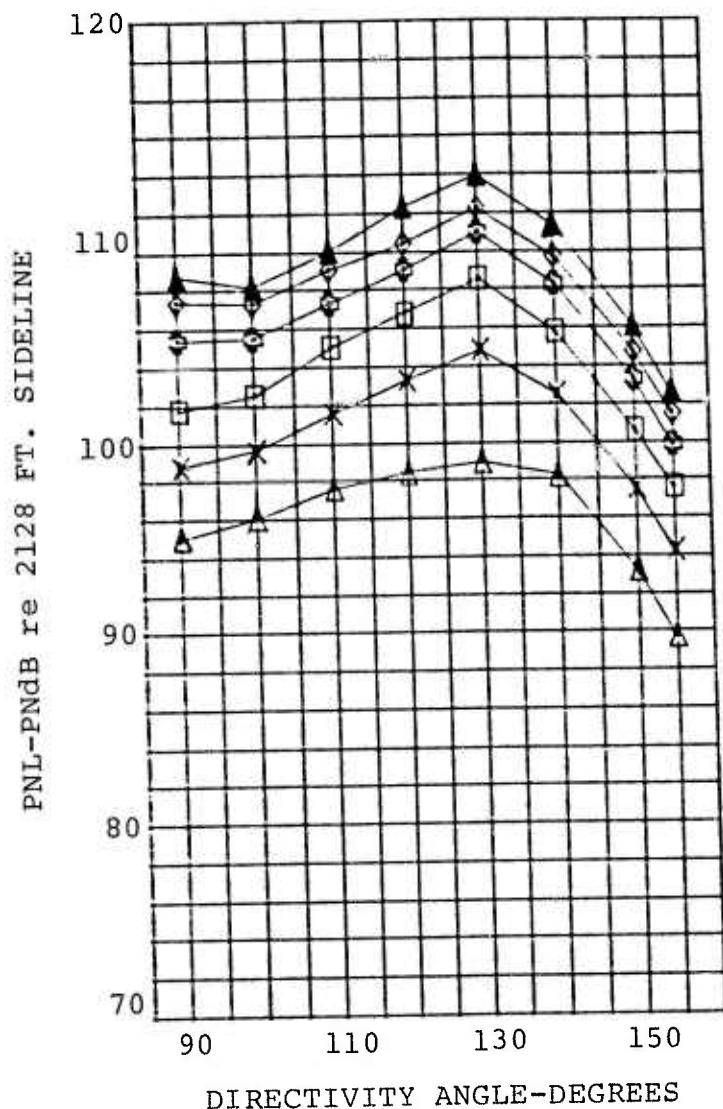
"NORMALIZED" 2128 FT. SIDELINE PNL

1400 1600 1800 2000 2200 2400 2600 2800 3000 3200
V-tilde FPS



PEAK PNL SUPPRESSION VALUES

NOZZLE: 42T/ANNULUS-2.6AR-CPA-ET/RC
(0.800" WIDE ANNULUS)

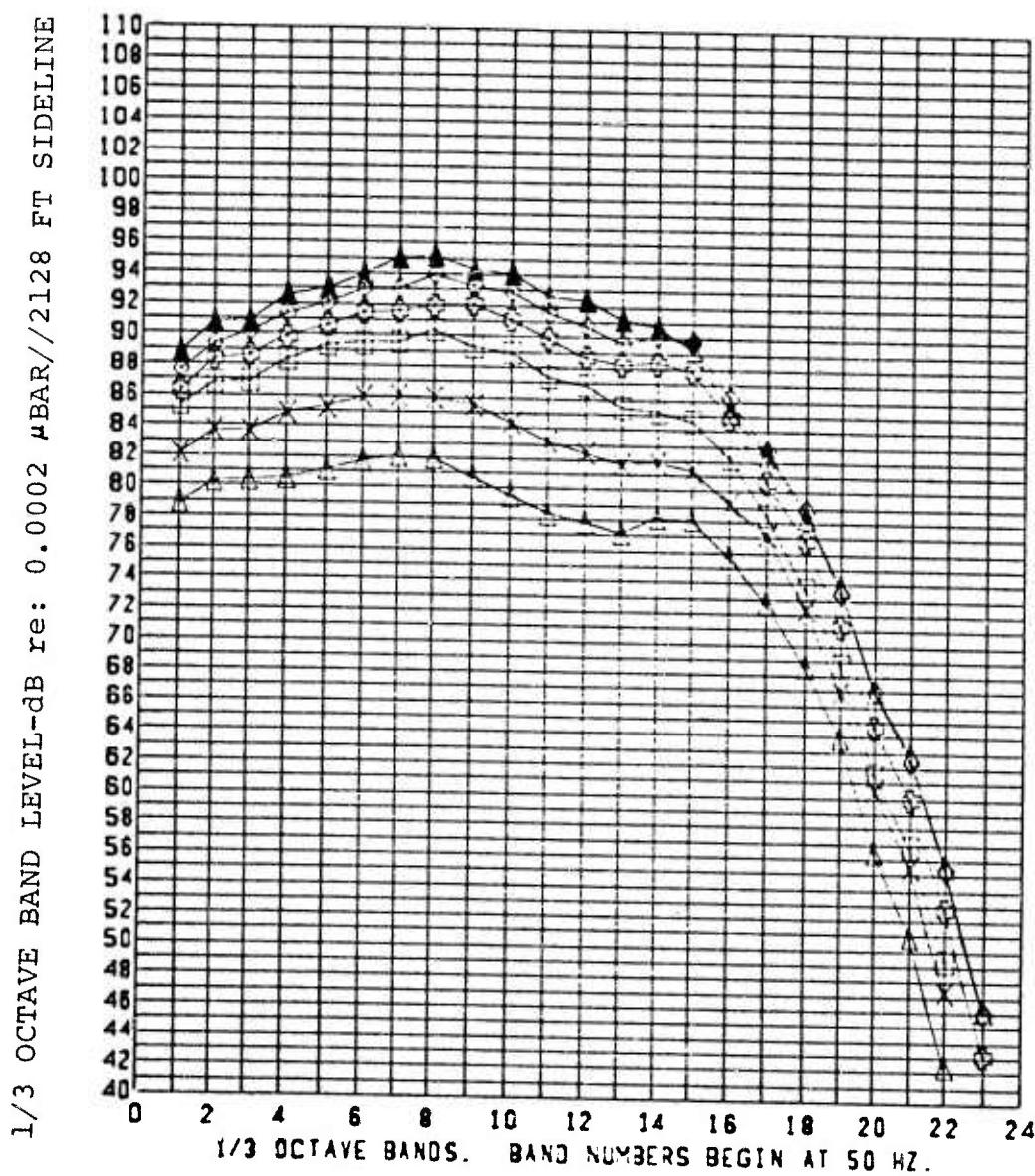


$T_T = 1150^{\circ}\text{F}$ $A_8 = 7.63 \text{ FT}^2$ RUN: 175
PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 3.4, \diamond 3.7, \blacktriangle 4.0

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



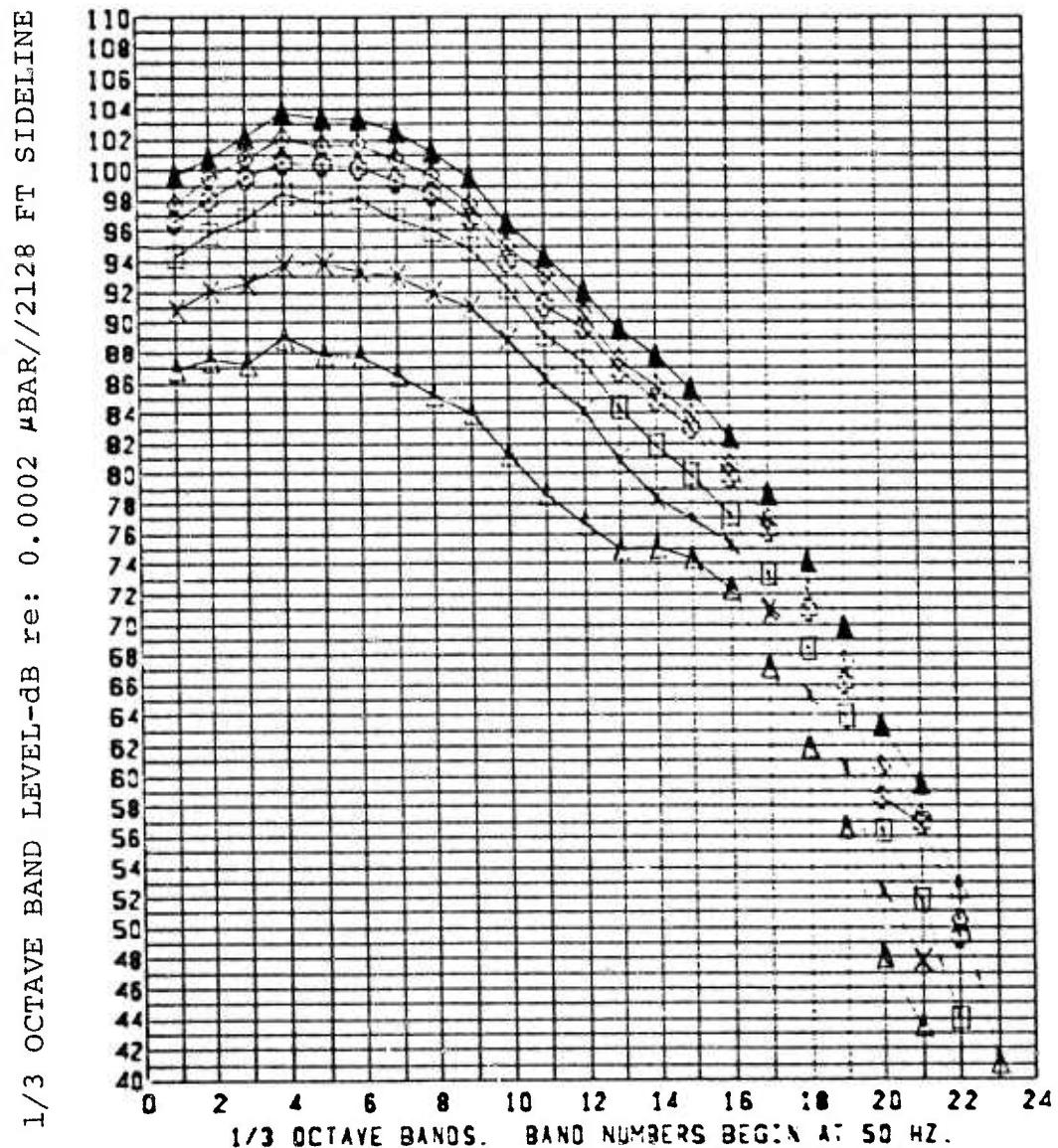
TT = 1150°F A8 = 7.63 FT² RUN: 175

PR = △ 2.0, X 2.5, □ 3.0, + 3.4, ◇ 3.7, ▲ 4.0

NOZZLE: 42T/ANNULUS-2.6AR-CPA-ET/RC
(0.800" WIDE ANNULUS)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
 ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 7.63 FT² RUN: 175

PR = ▲ 2.0, X 2.5, □ 3.0, + 3.4, ◊ 3.7, ▲ 4.0

NOZZLE: 42T/ANNULUS-2.6AR-CPA-ET/RC
 (0.800' WIDE ANNULUS)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°

re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 42T/Annulus-2.4AR-CPA-ET/RC

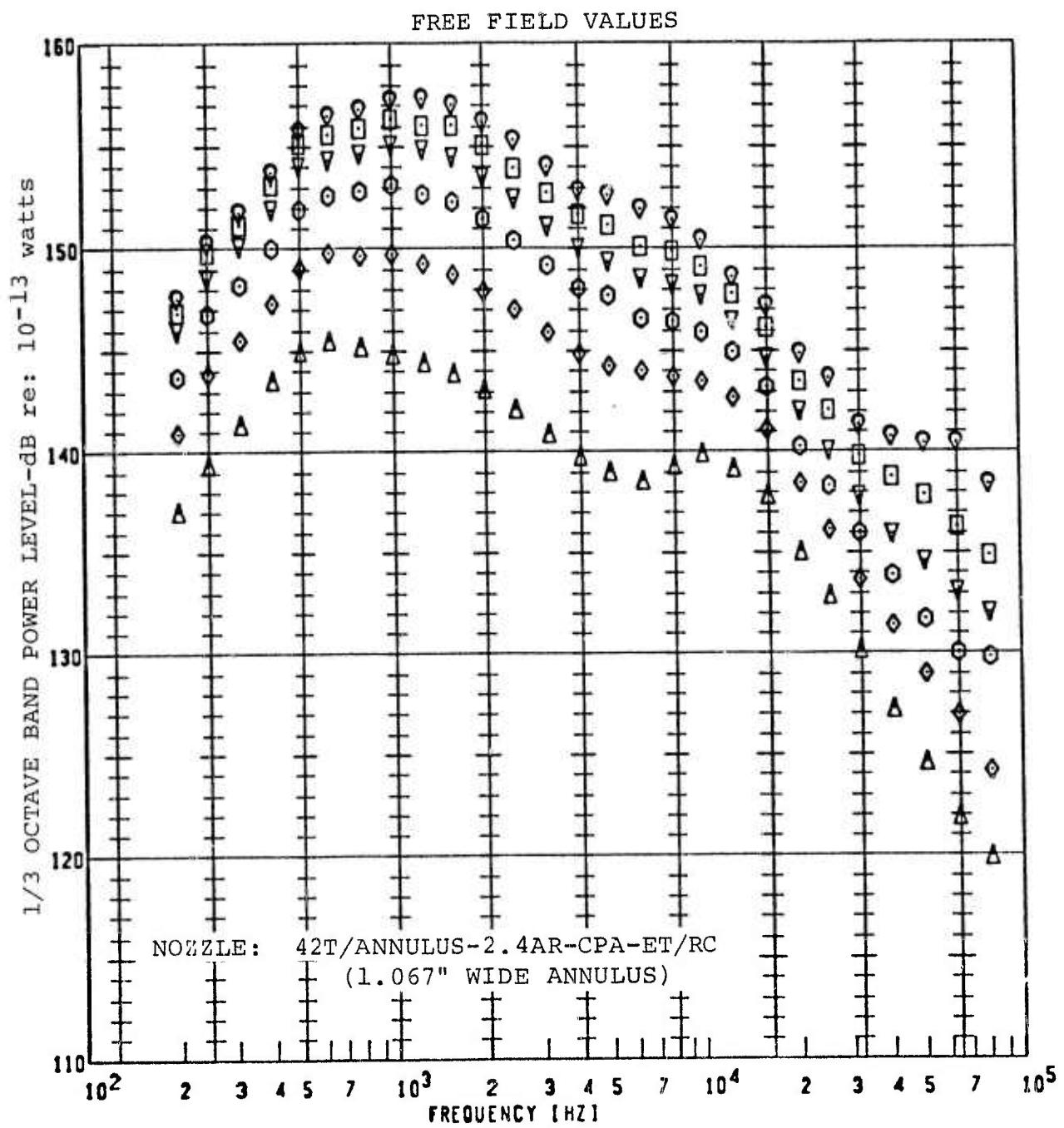
FACILITY:

DATE: 10-15-73 **T_{AMB}** = 61°F **R.H.** = 82%

SCALE MODEL A₈ = 18.9 in.²

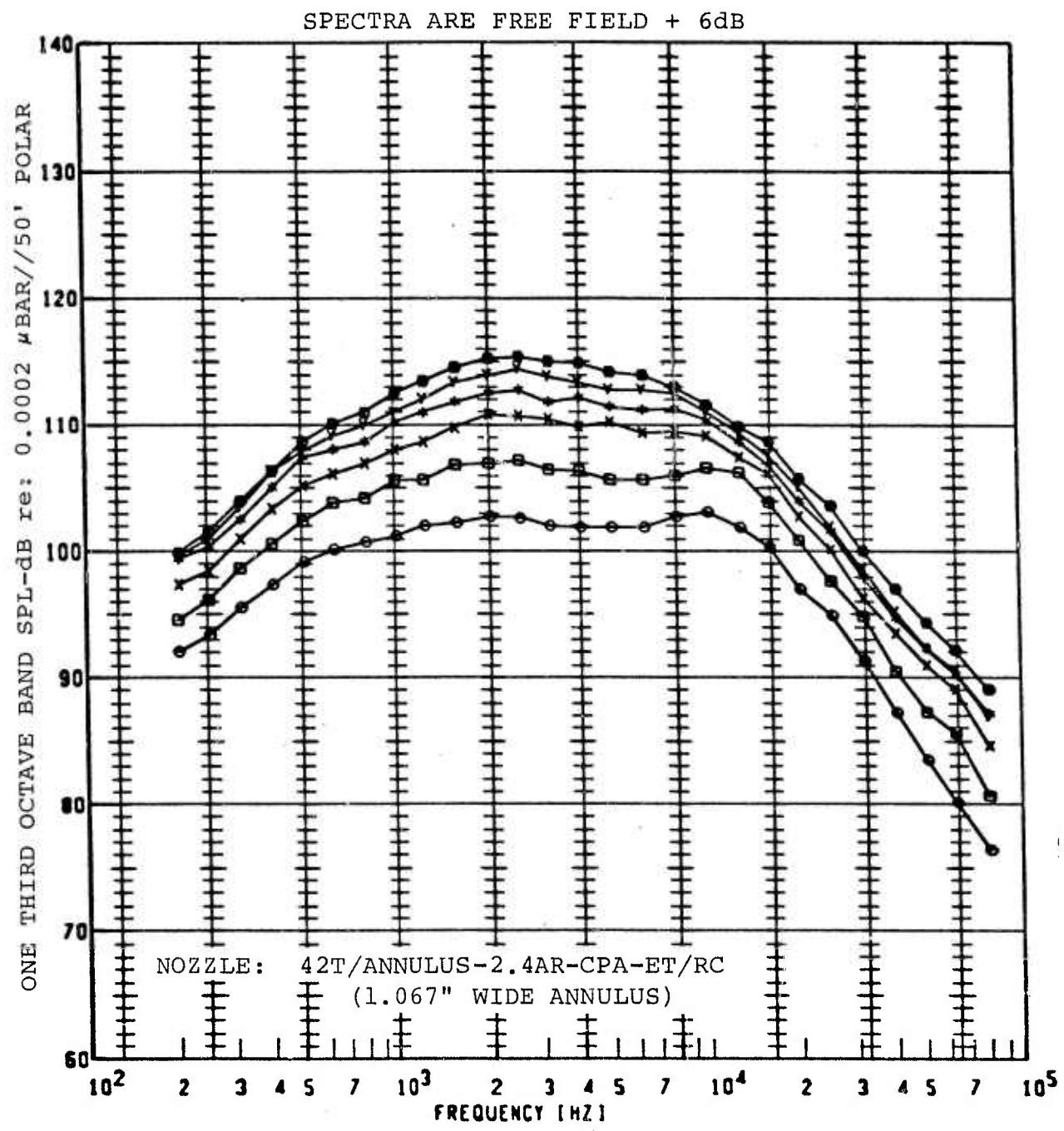
RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
167	2.0	1150°F	1875 fps	Annulus width =	
"	2.5	"	2126	1.067"	
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



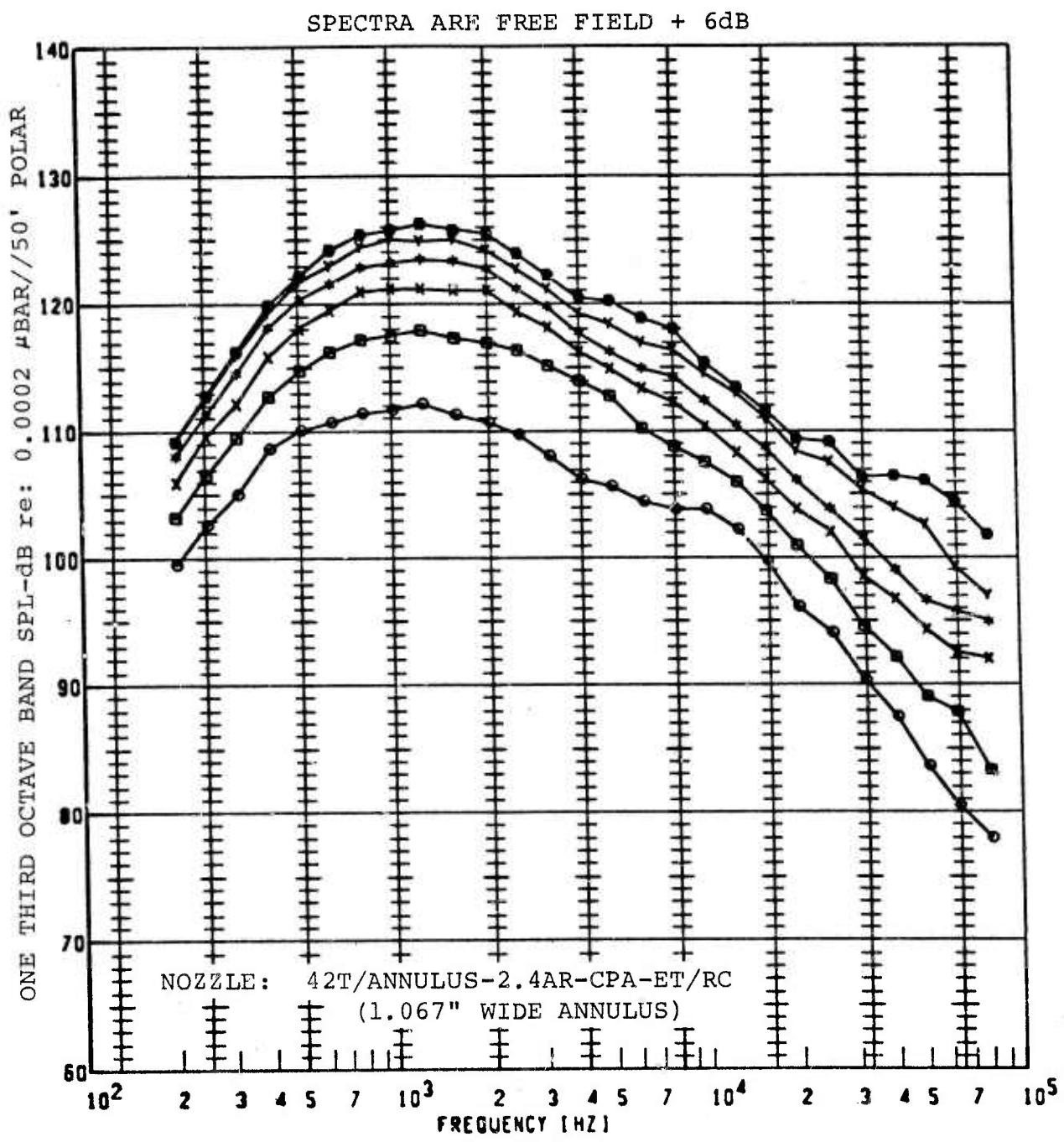
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	167	2.00	1150°F
◊	167	2.50	1150
○	167	3.00	1150
▽	167	3.40	1150
□	167	3.70	1150
×	167	4.00	1150

JET NOISE POWER SPECTRA



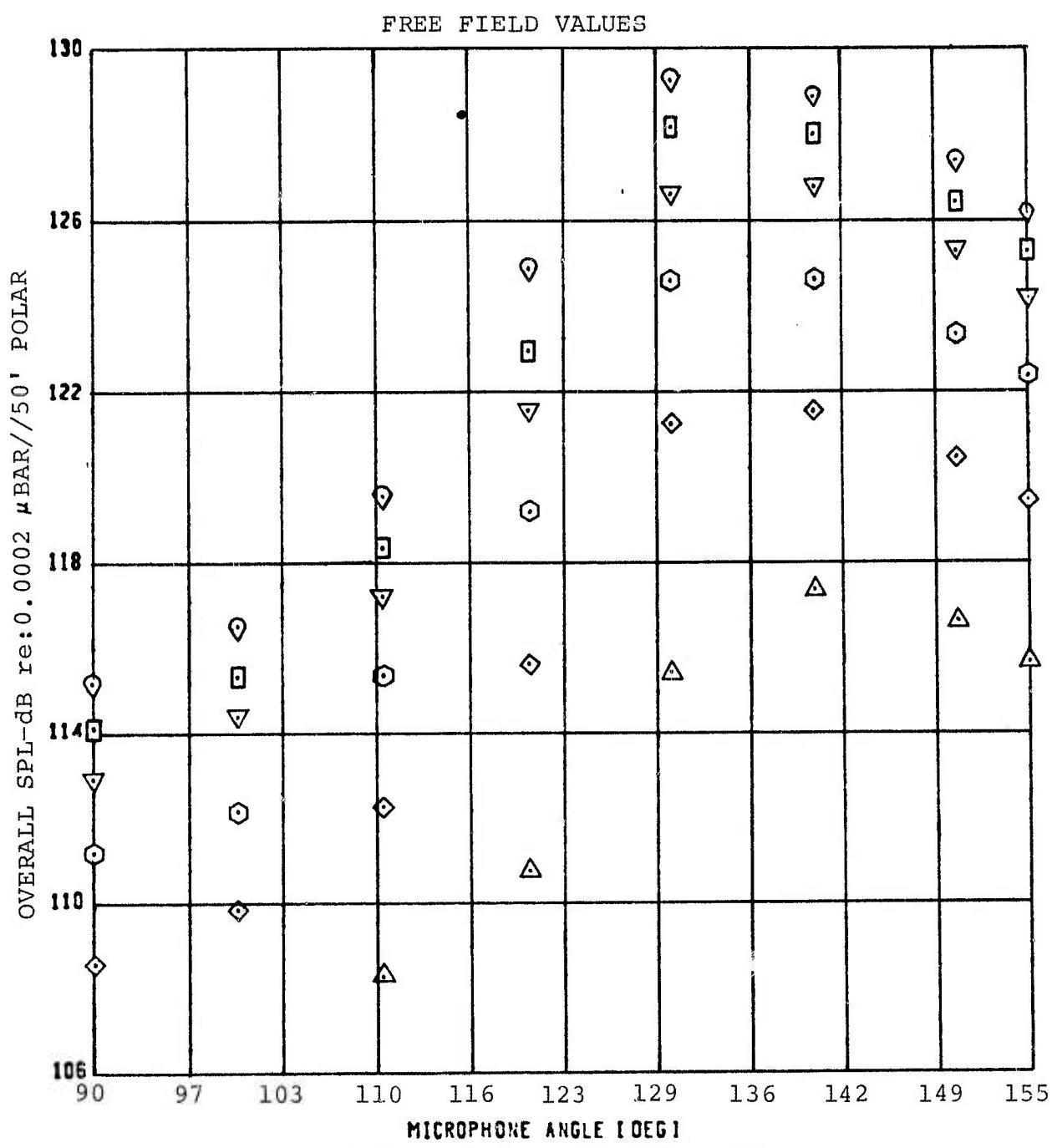
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL [DB]
●	167G	1150° F	2.000	110°	SOPP	114.2
■	167G	1150	2.500		SOPP	118.2
x	167G	1150	3.000		SOPP	121.3
*	167G	1150	3.400		SOPP	123.0
▼	167G	1150	3.700		SOPP	124.3
●	167G	1150	4.000		SOPP	125.4

MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



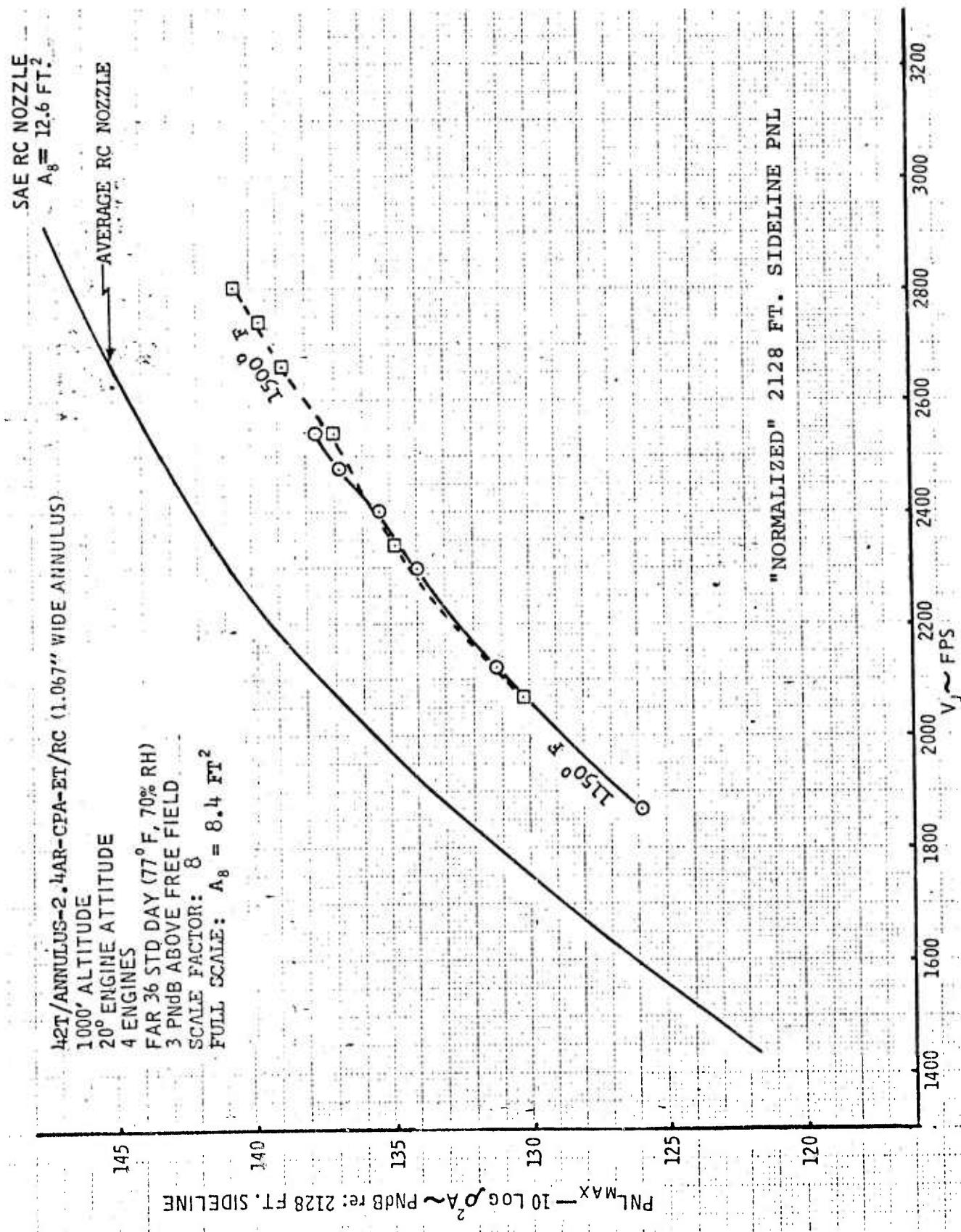
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [dB]
●	167G	1150°F	2.000	130°	SOFP	121.5
■	167G	1150	2.500		SOFP	127.3
×	167G	1150	3.000		SOFP	130.6
*	167G	1150	3.400		SOFP	132.6
♦	167G	1150	3.700		SOFP	134.2
●	167G	1150	4.000		SOFP	135.2

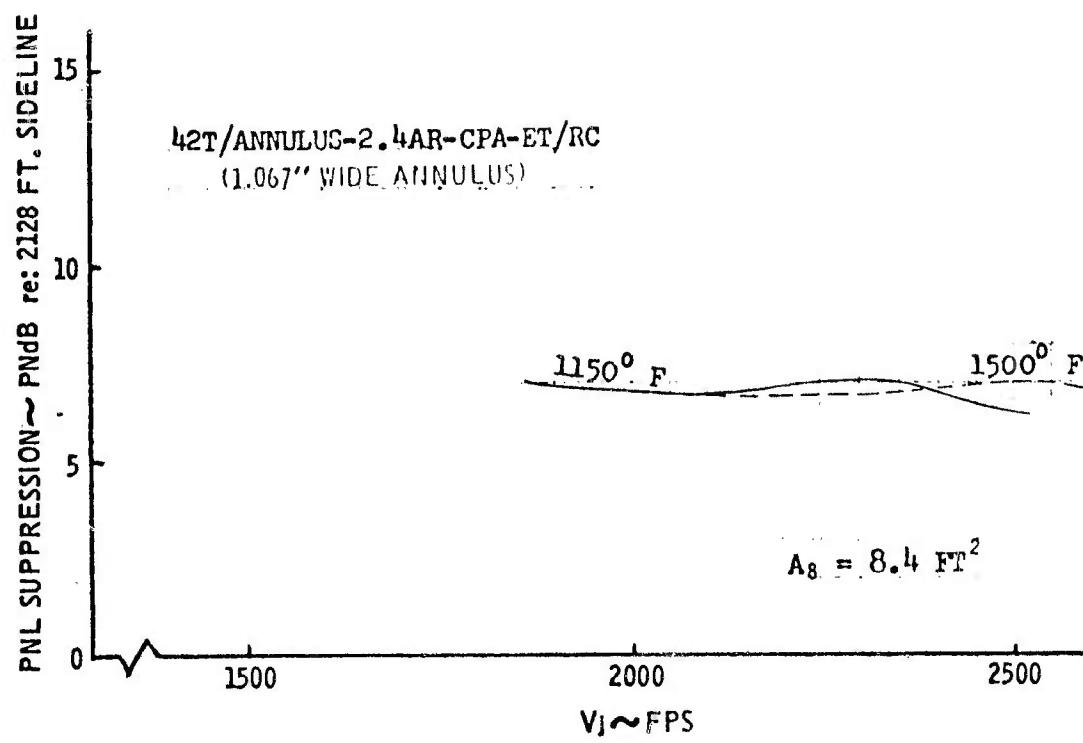
MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS



NOZZLE: 42T/ANNULUS-2.4AR-CPA-ET/RC
(1.067" WIDE ANNULUS)

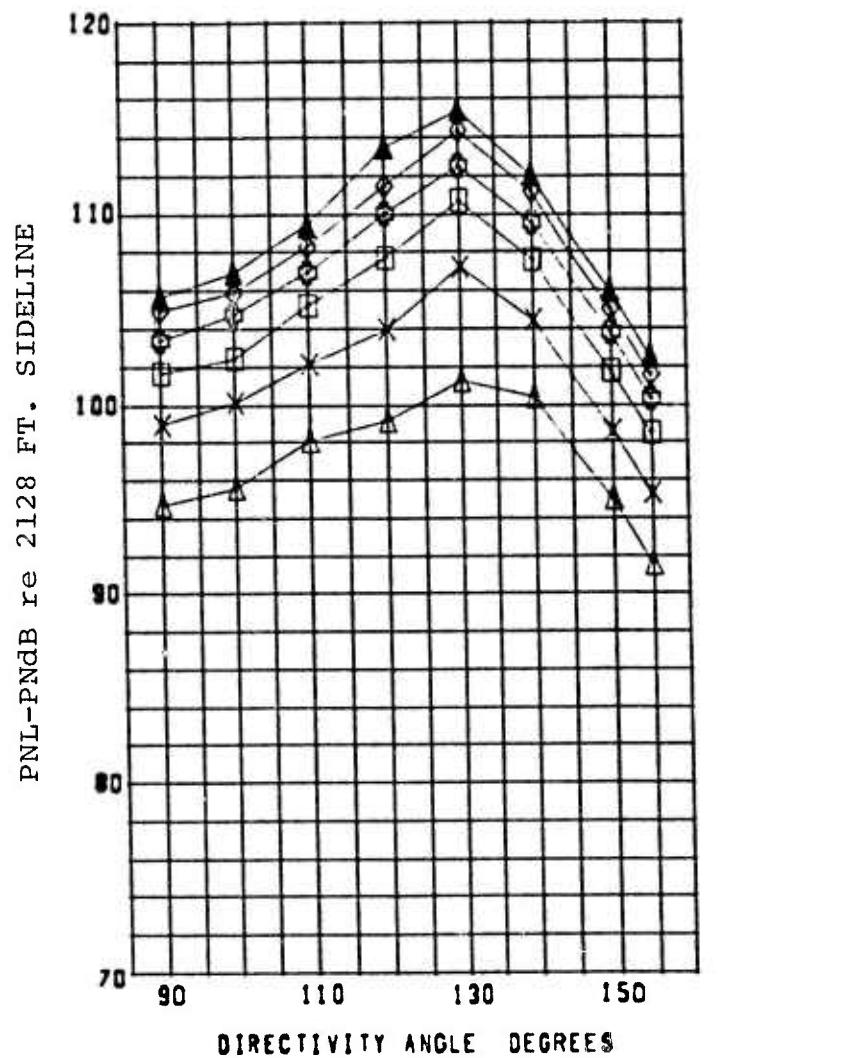
OASPL BEAM PATTERNS





PEAK PNL SUPPRESSION VALUES

NOZZLE: 42T/ANNULUS-2.4AR-CPA-ET/RC
(1.067" WIDE ANNULUS)

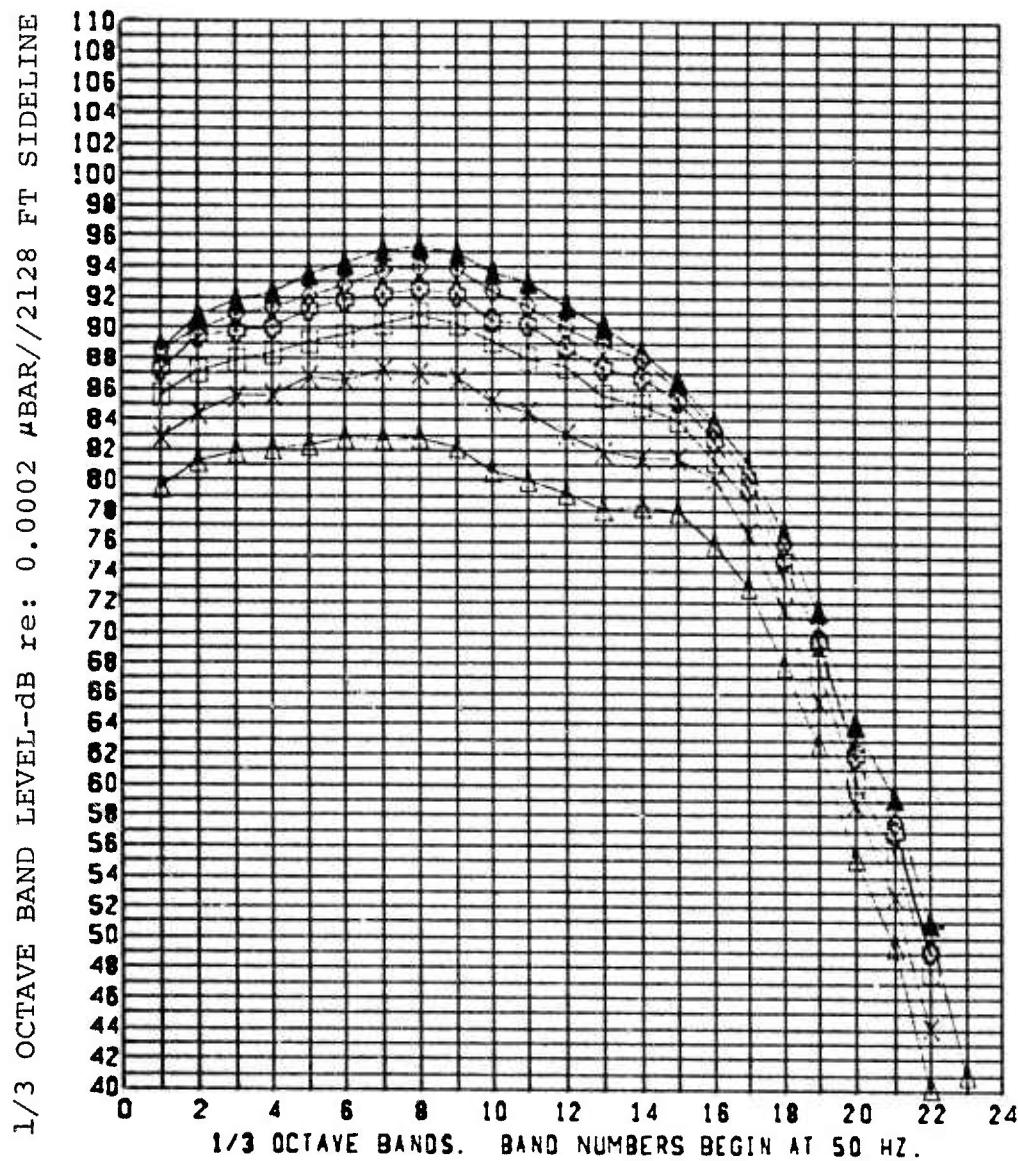


TT = 1150°F A8 = 8.4 FT² RUN: 167
PR = △ 2.0, × 2.5, □ 3.0, + 3.4, ◇ 3.7, ▲ 4.0

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 8.4 FT² RUN: 167

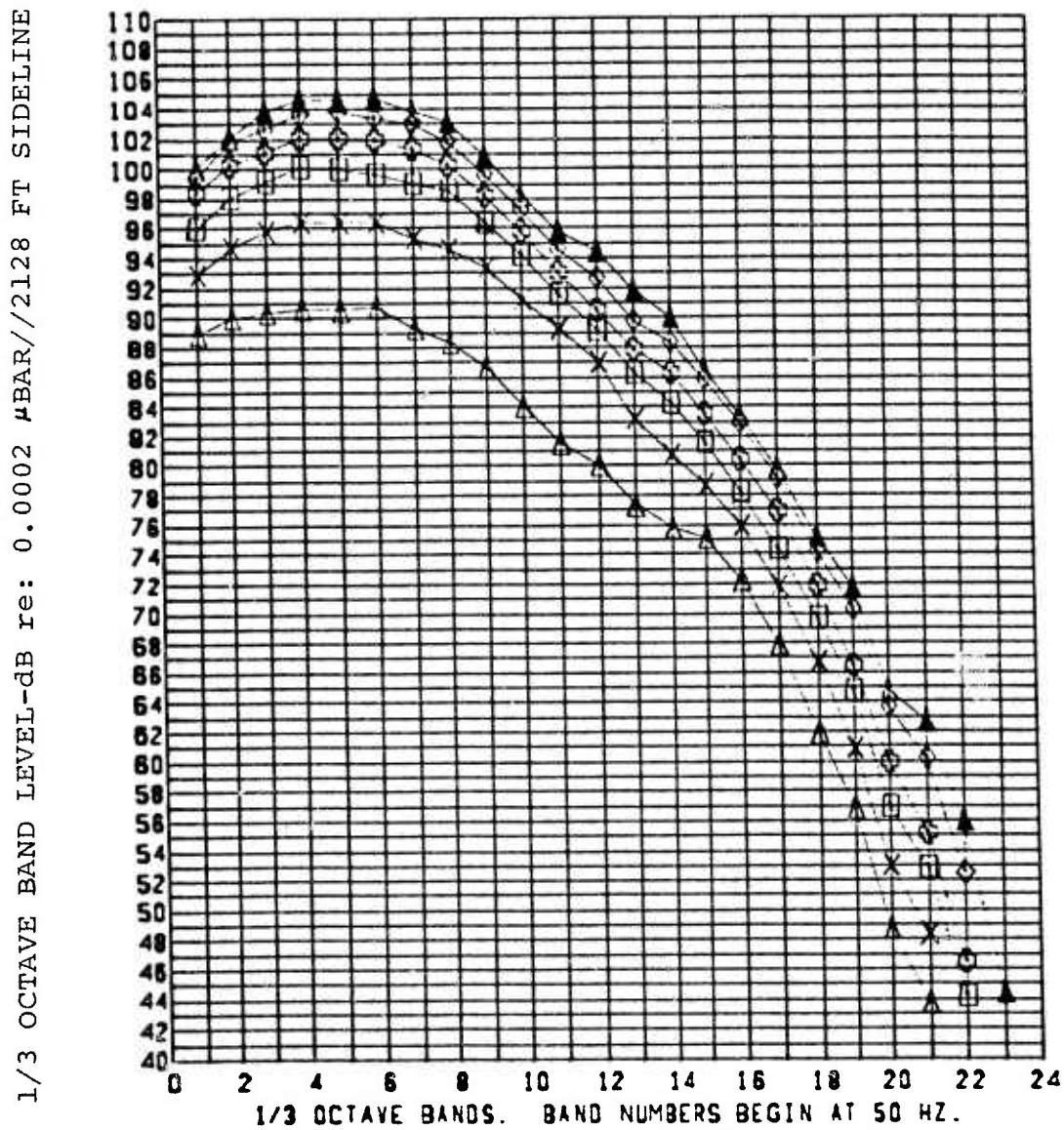
PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.4, \diamond 3.7, \blacktriangle 4.0

NOZZLE: 42T/ANNULUS-2.4AR-CPA-ET/RC
(1.067" WIDE ANNULUS)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
re: NOZZLE INLET AXIS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 130 TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 8.4 FT² RUN: 167

PR = △ 2.0, X 2.5, □ 3.0, + 3.4, ◇ 3.7, ▲ 4.0

NOZZLE: 42T/ANNULUS-2.4AR-CPA-ET/RC
(1.067" WIDE ANNULUS)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°

re: NOZZLE INLET AXIS

TEST CONDITIONS

NOZZLE: 42T/Annulus-2.1AR-CPA-ET/RC

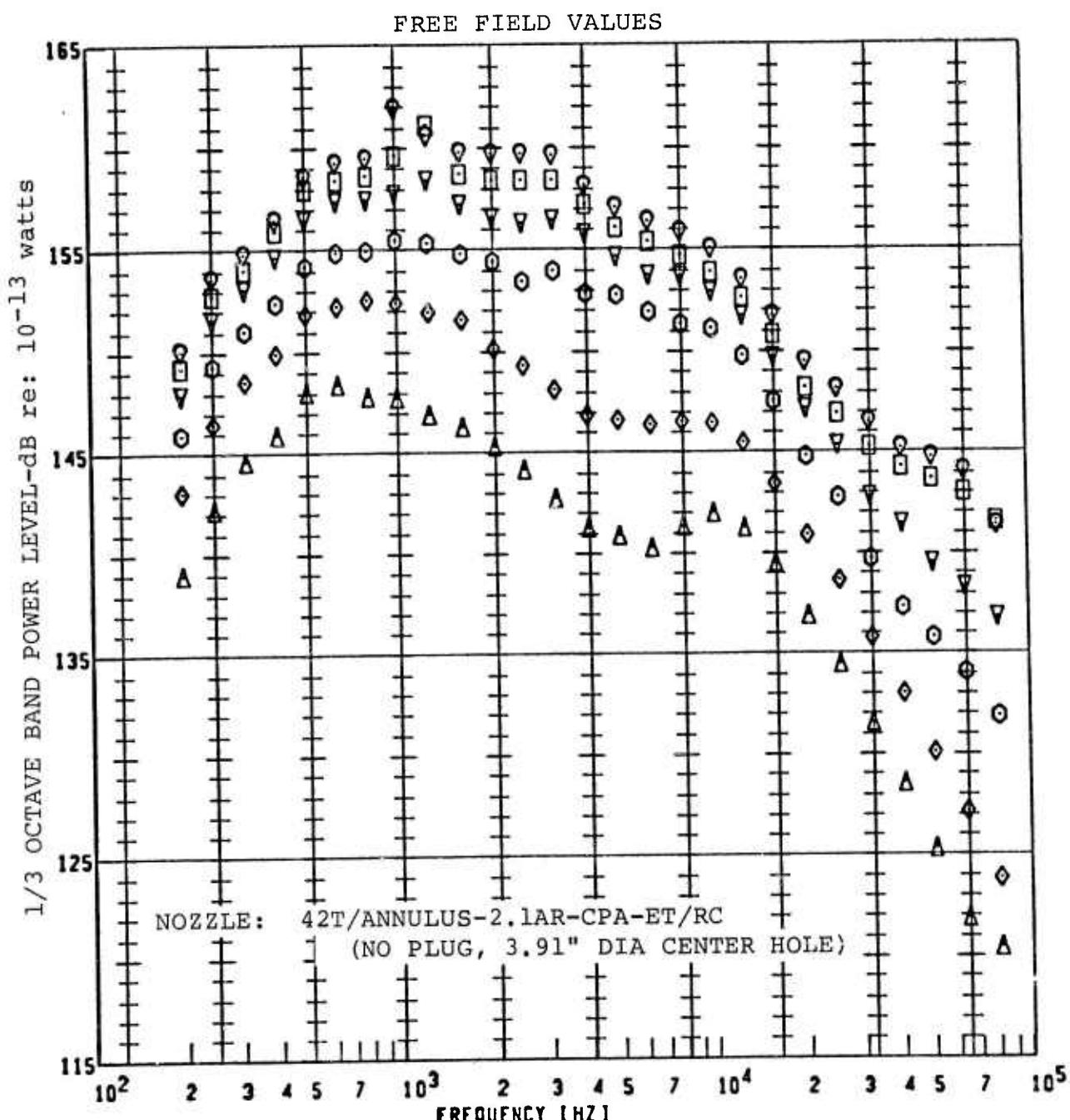
FACILITY: HNTF

DATE: 10-16-73 **T_{AMB}** = 58°F **R.H.** = 83%

SCALE MODEL A₈ = 21.3 in.²

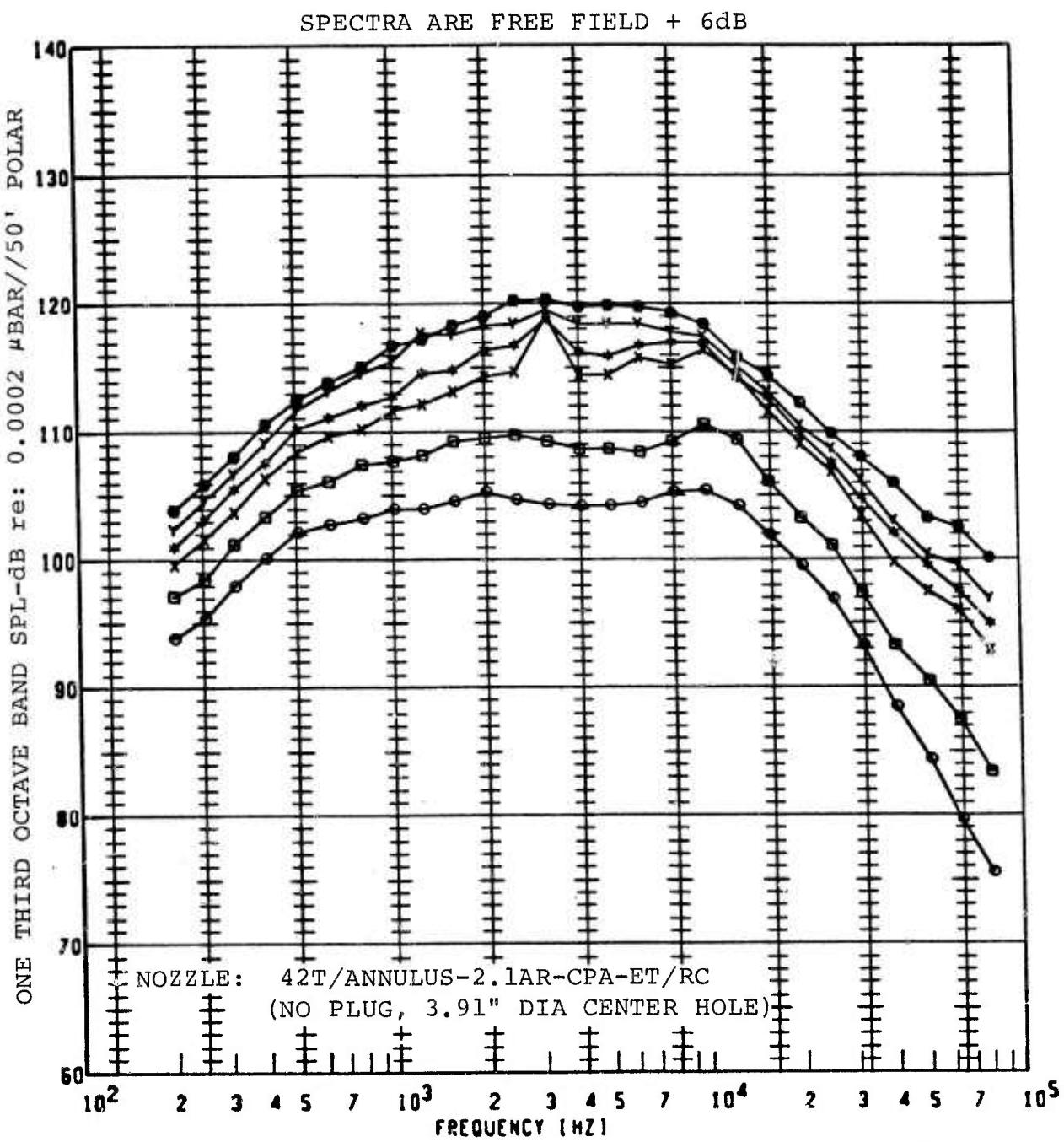
<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
171	2.0	1150°F	1875 fps	No Plug,	
"	2.5	"	2126	3.91" Dia. center hole	
"	3.0	"	2303		
"	3.4	"	2413		
"	3.7	"	2483		
"	4.0	"	2544		

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



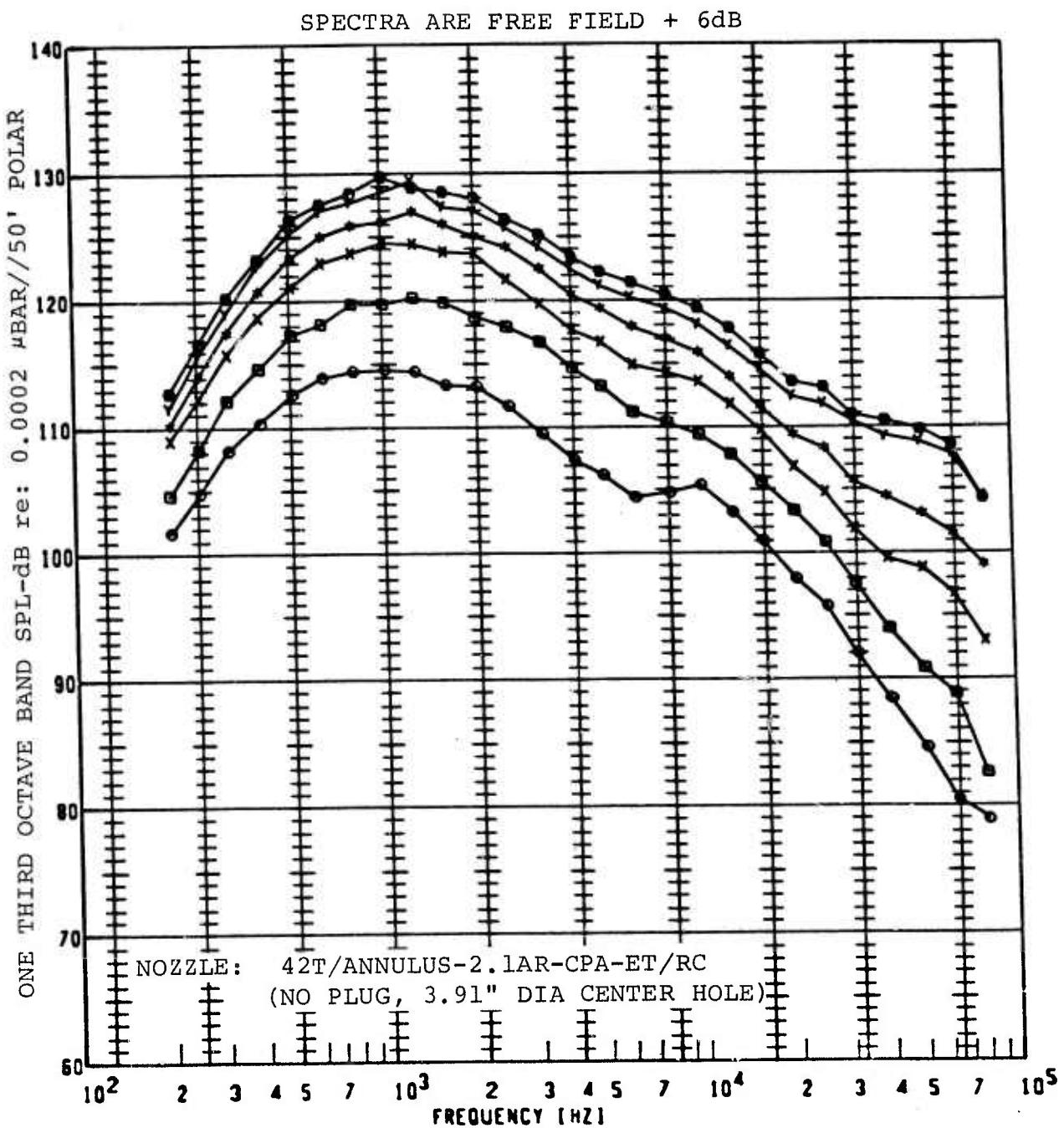
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	171	2.00	1150°F
◊	171	2.50	1150
○	171	3.00	1150
▽	171	3.40	1150
□	171	3.70	1150
○	171	4.00	1150

JET NOISE POWER SPECTRA



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	OASPL [DB]
●	171G	1150°F	2.000	110°	50FP	116.6
■	171G	1150	2.500		50FP	121.0
x	171G	1150	3.000		50FP	126.6
*	171G	1150	3.400		50FP	127.7
▽	171G	1150	3.700		50FP	129.4
●	171G	1150	4.000		50FP	130.4

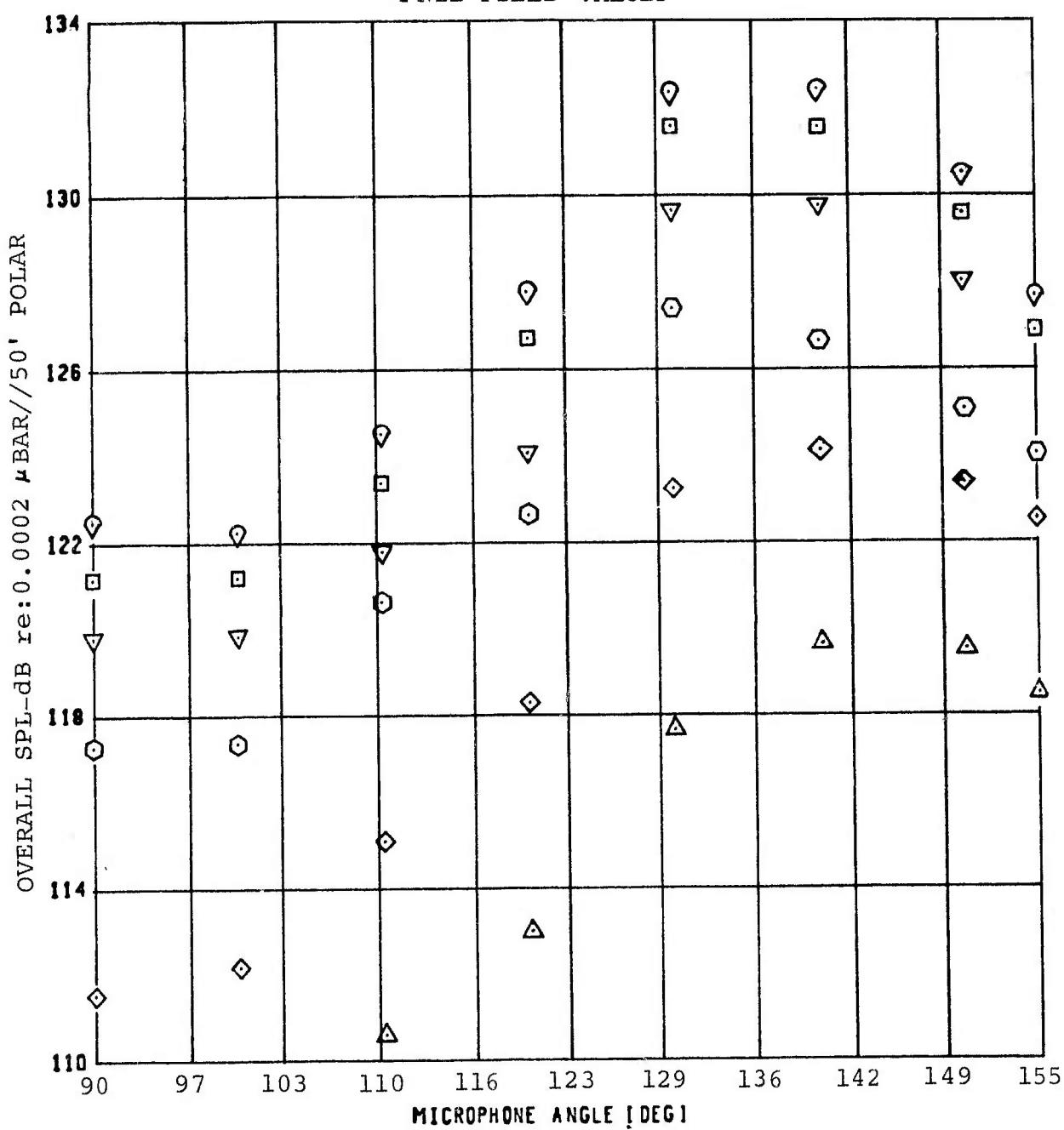
MEASURED NOISE SPECTRA AT 110° re: NOZZLE INLET AXIS



PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [dB]
●	171G	1150°F	2.000	130°	50FP	123.8
■	171G	1150	2.500		50FP	129.3
×	171G	1150	3.000		50FP	133.4
*	171G	1150	3.400		50FP	135.6
▽	171G	1150	3.700		50FP	137.6
●	171G	1150	4.000		50FP	138.3

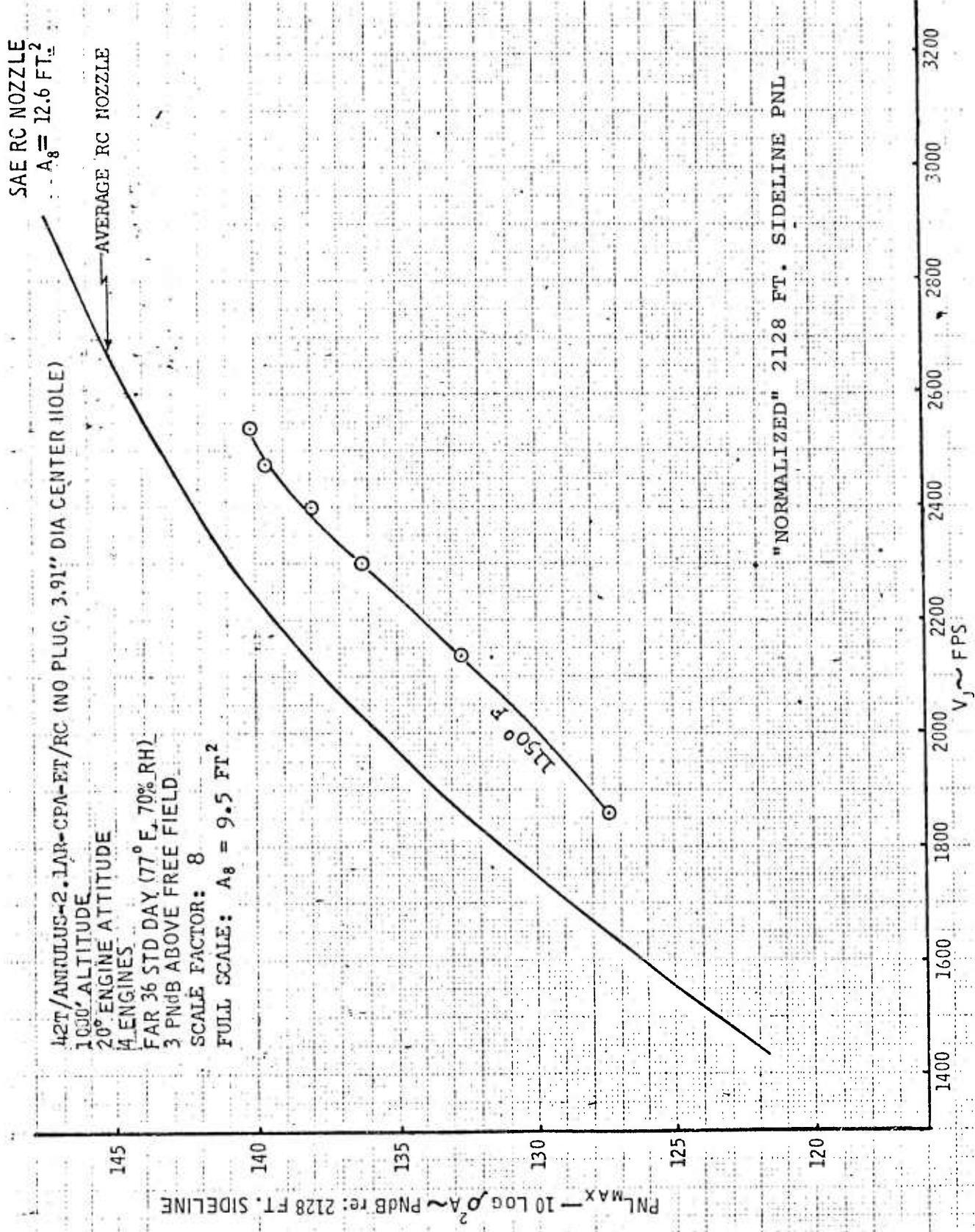
MEASURED NOISE SPECTRA AT 130° re: NOZZLE INLET AXIS

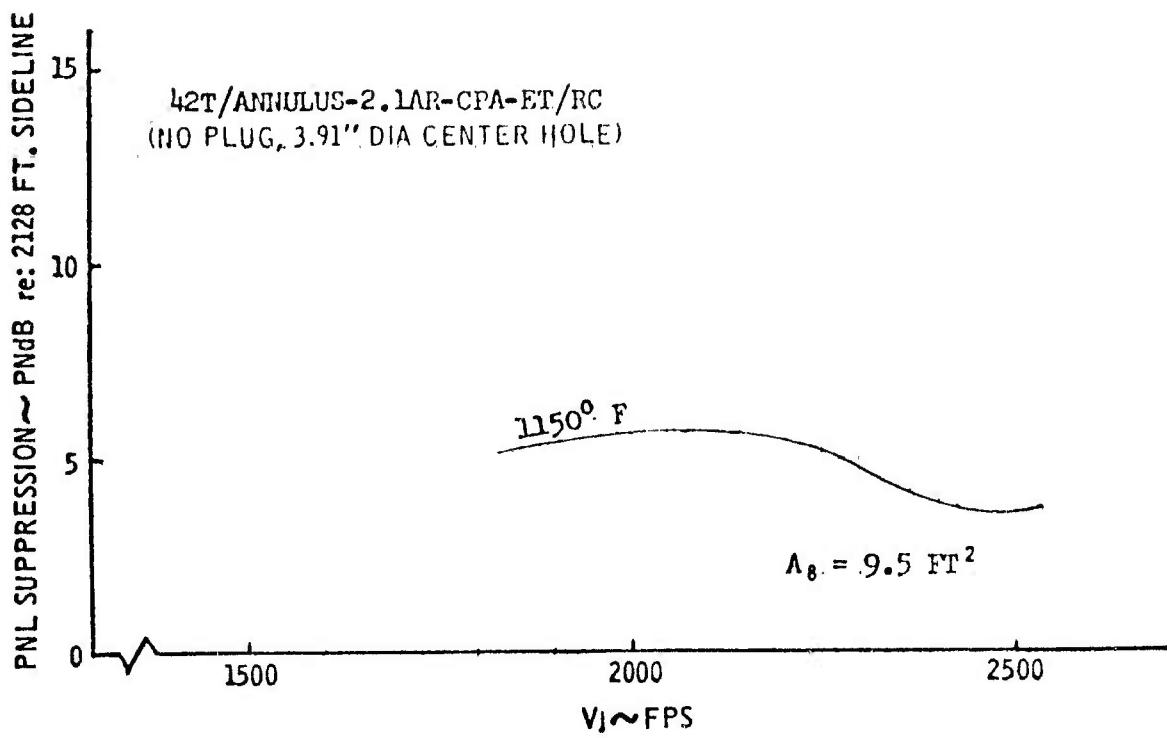
FREE FIELD VALUES



NOZZLE: 42T/ANNULUS-2.1AR-CPA-ET/RC
(NO PLUG, 3.91" DIA CENTER HOLE)

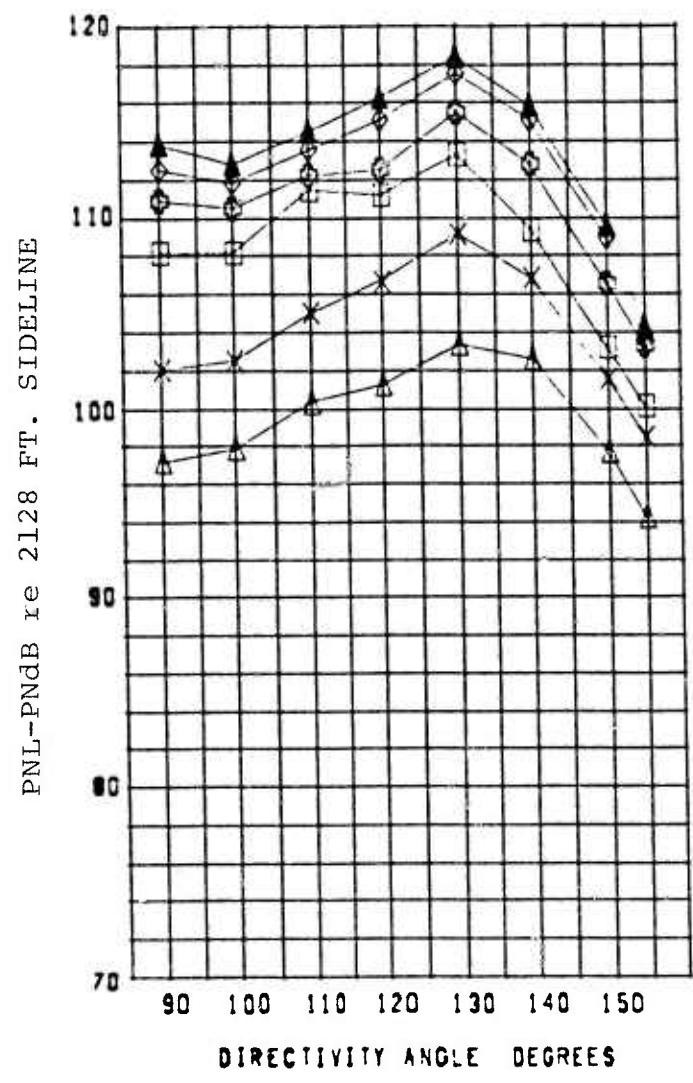
OASPL BEAM PATTERNS





PEAK PNL SUPPRESSION VALUES

NOZZLE: 42T/ANNULUS-2.1AR-CPA-ET/RC
(NO PLUG, 3.910" CENTER HOLE)

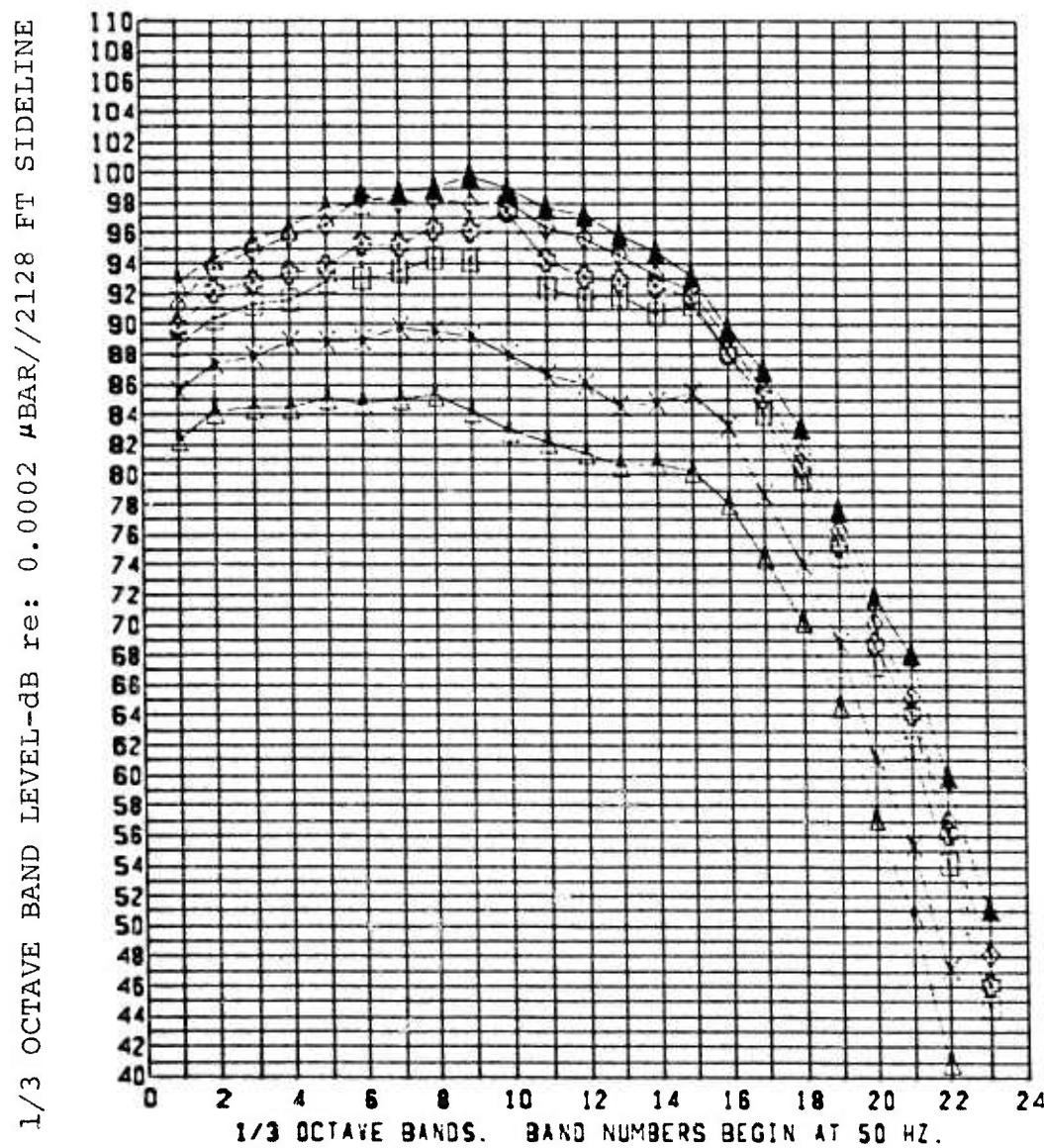


TT = 1150°F A8 = 9.5 FT² RUN: 171
PR = Δ 2.0, X 2.5, □ 3.0, + 3.4, ◊ 3.7, ▲ 4.0

PNL BEAM PATTERNS

ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES

ANGLE = 110 DEG TEMP = 77 DEG R.H. = 70 PER CENT



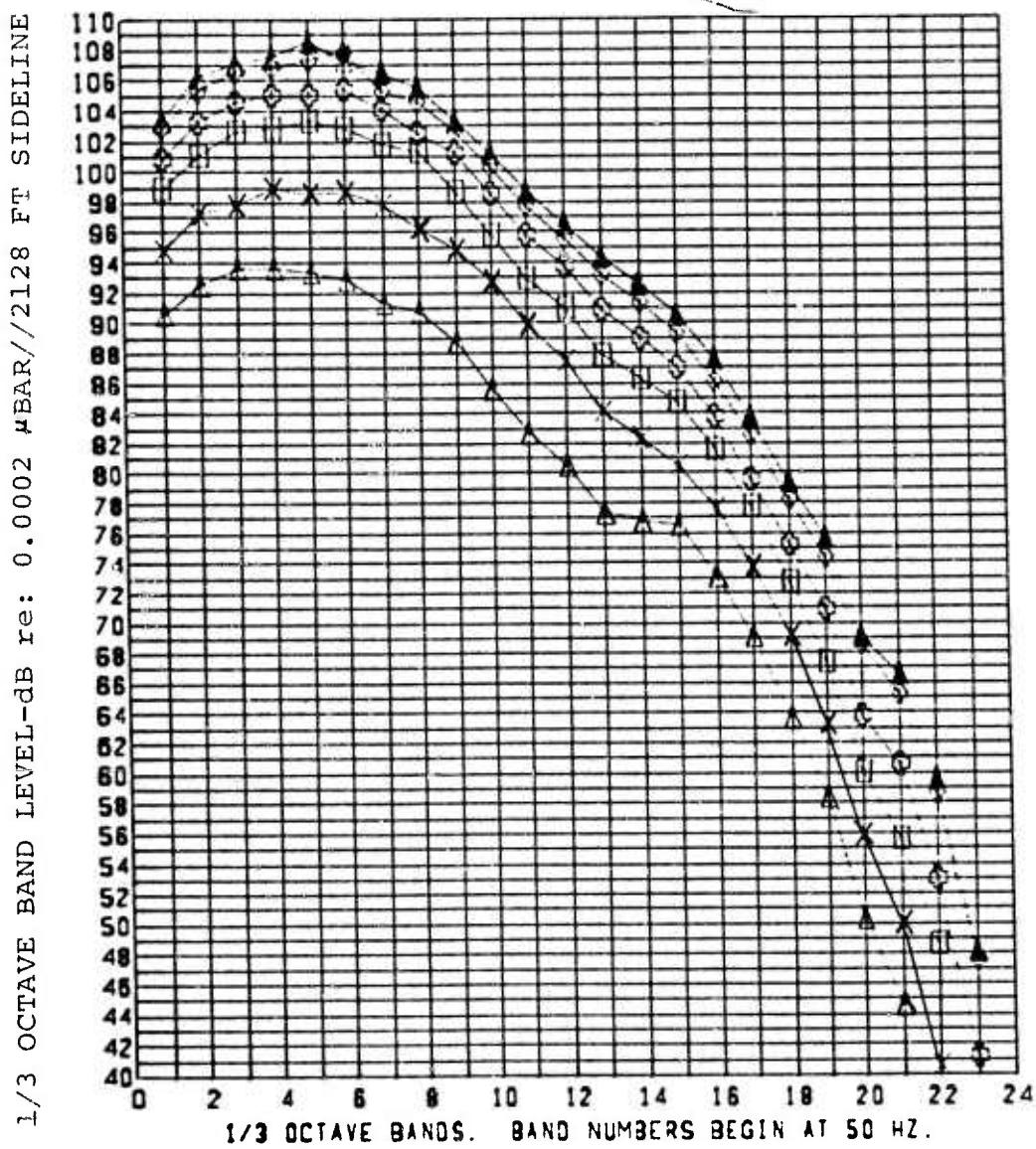
TT = 1150°F A8 = 9.5 FT² RUN: 171

PR = Δ 2.0, \times 2.5, \square 3.0, \pm 3.4, \diamond 3.7, \blacktriangle 4.0

NOZZLE: 42T/ANNULUS-2.1AR-CPA-ET/RC
(NO PLUG, 3.91" DIA CENTER HOLE)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 110°
re: NOZZLE INLET AXIS

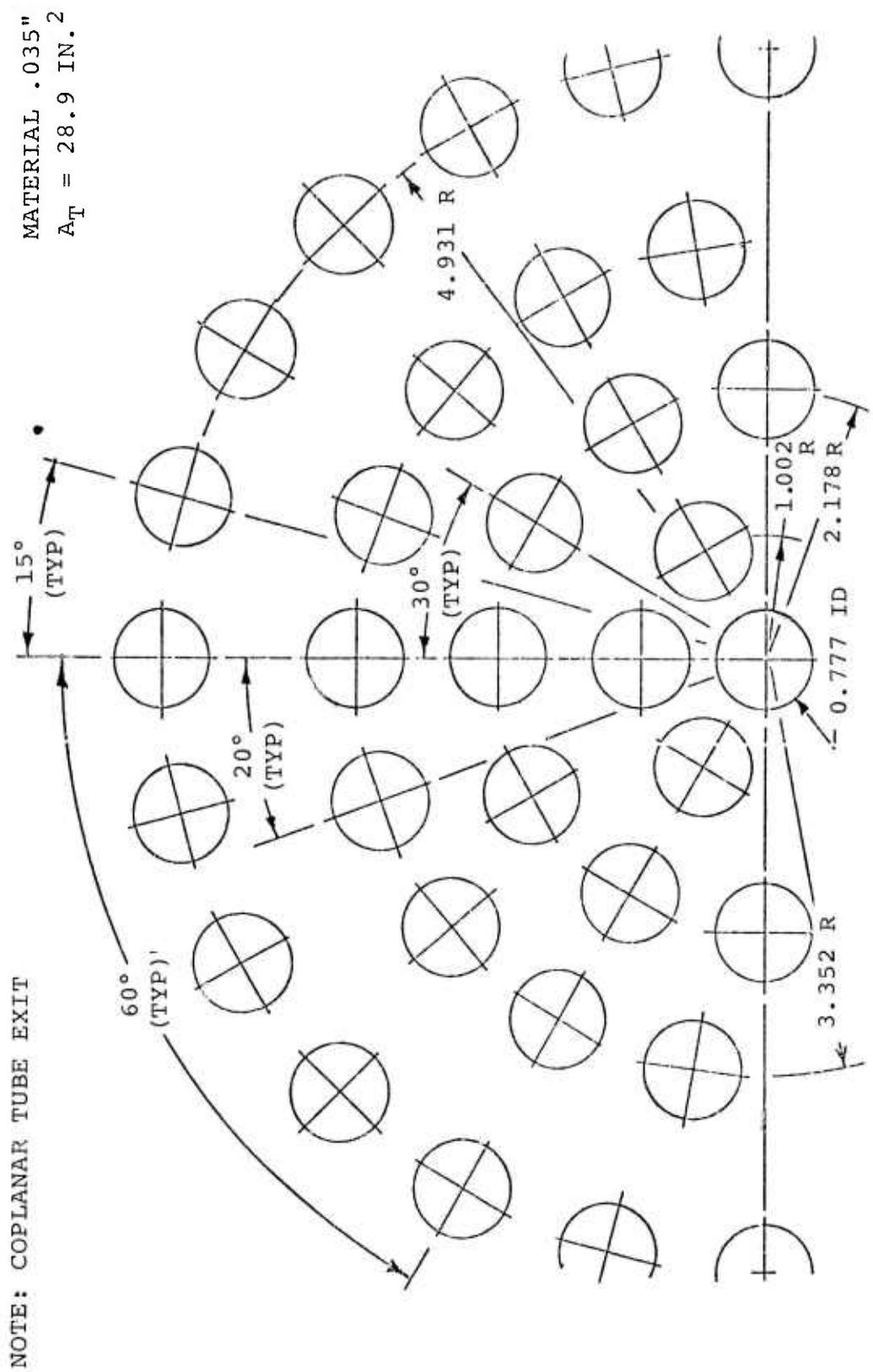
ALT = 1000 FT, VEL = 0 FPS, S.L. = 2128 FT, 4 ENGINES
ANGLE = 130 DEG TEMP = 77 DEG R.H. = 70 PER CENT



TT = 1150°F A8 = 9.5 FT² RUN: 171
PR = Δ 2.0, \times 2.5, \square 3.0, \oplus 3.4, \diamond 3.7, \blacktriangle 4.0

NOZZLE: 42T/ANNULUS-2.1AR-CPA-ET/RC
(NO PLUG, 3.91" DIA CENTER HOLE)

JET NOISE SPECTRA AT THE 2128 FT. SIDELINE, 130°
re: NOZZLE INLET AXIS



61 TUBE AR 3.07 NOZZLE EXIT FLOW PATTERN

TEST CONDITIONS

NOZZLE: 61T-3.1AR-CPA-RT/NC

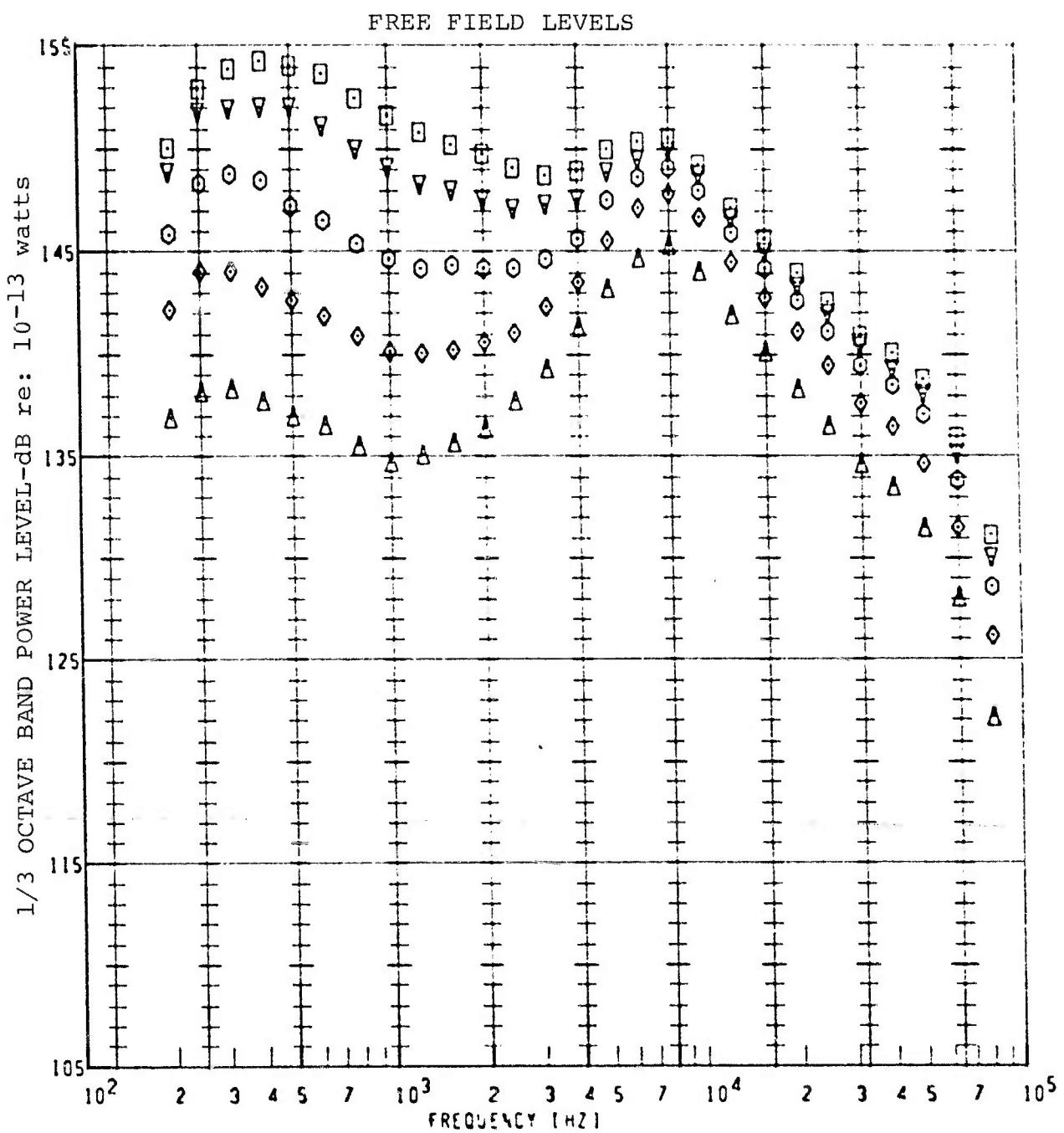
FACILITY: HNTF

DATE: 11-26-73 **T_{AMB}** = 41°F **R.H.** = 91%

SCALE MODEL A₈ = 28.9 in.²

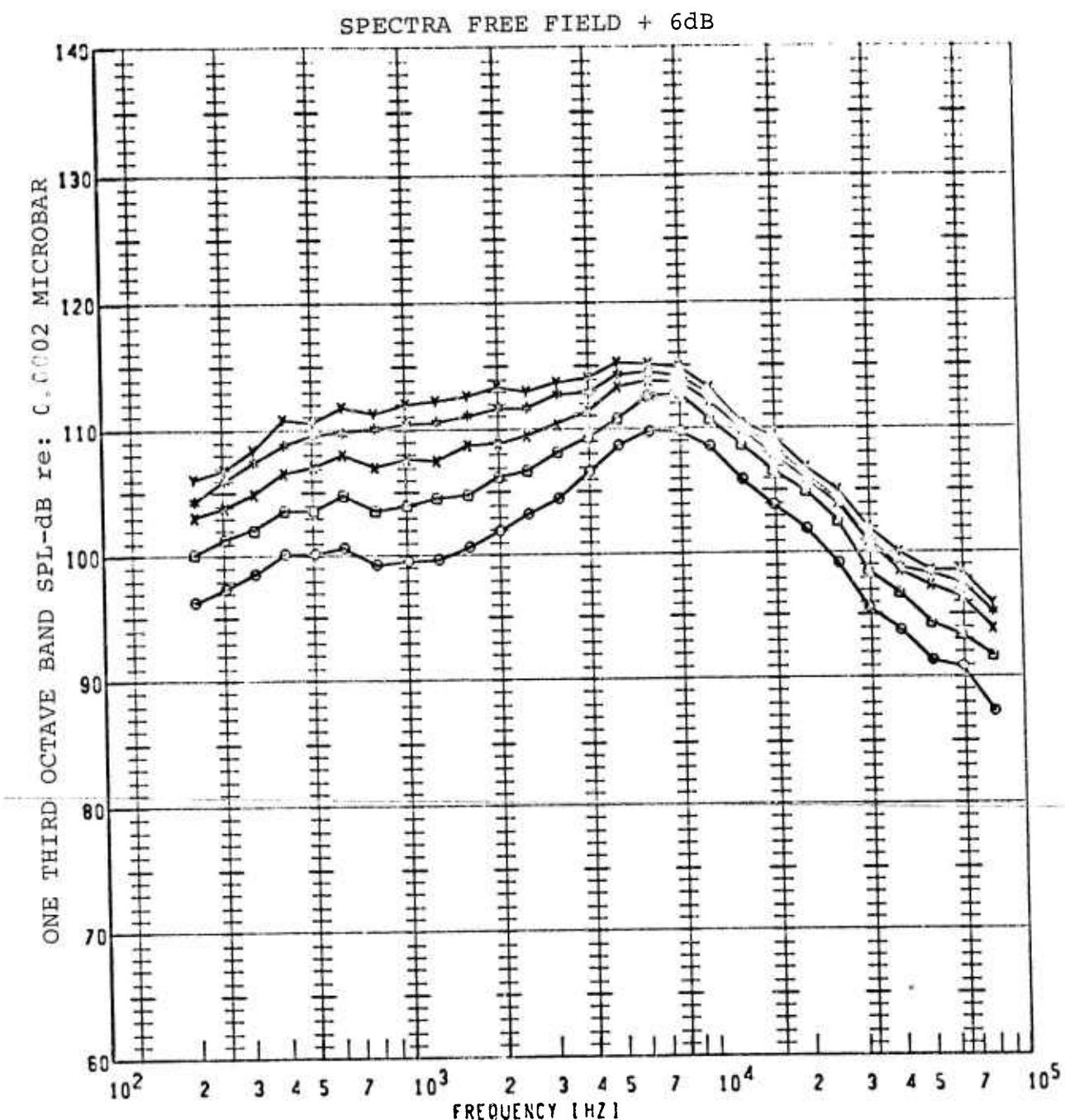
RUN NO.	NPR	T_t	V_J (IDEAL)	REMARKS	REF
07	2.0	1500°F	2072 fps	11-26-73	
"	2.5	"	2351	"	
"	3.0	"	2548	"	
"	3.5	"	2697	"	
"	3.8	"	2771	"	

MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.

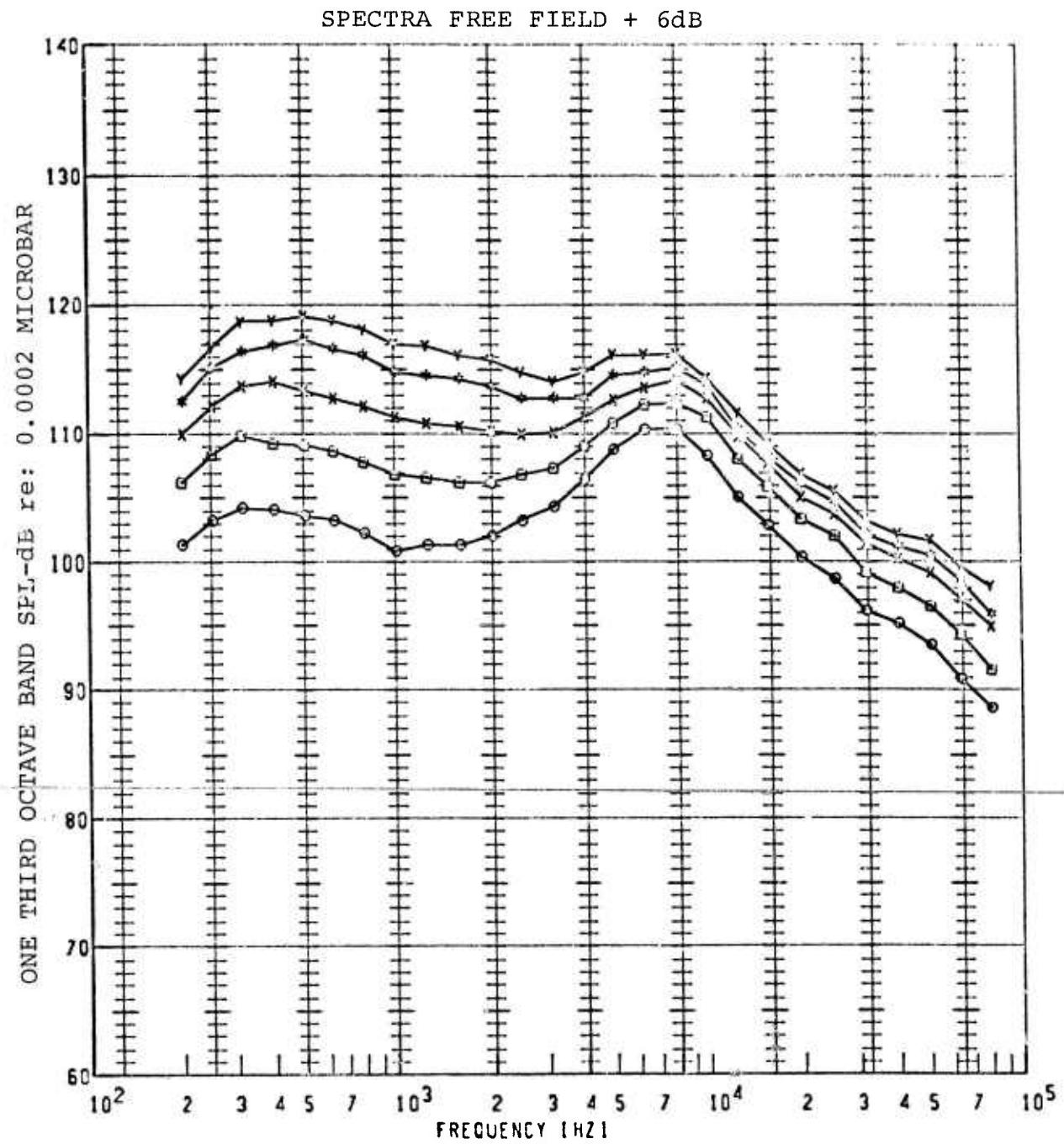


PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
▲	07	2.00	1500°F
◇	07	2.50	1500
○	07	3.00	1500
▽	07	3.50	1500
□	07	3.80	1500

61T-3.1AR-CPA-RT/NC NOZZLE

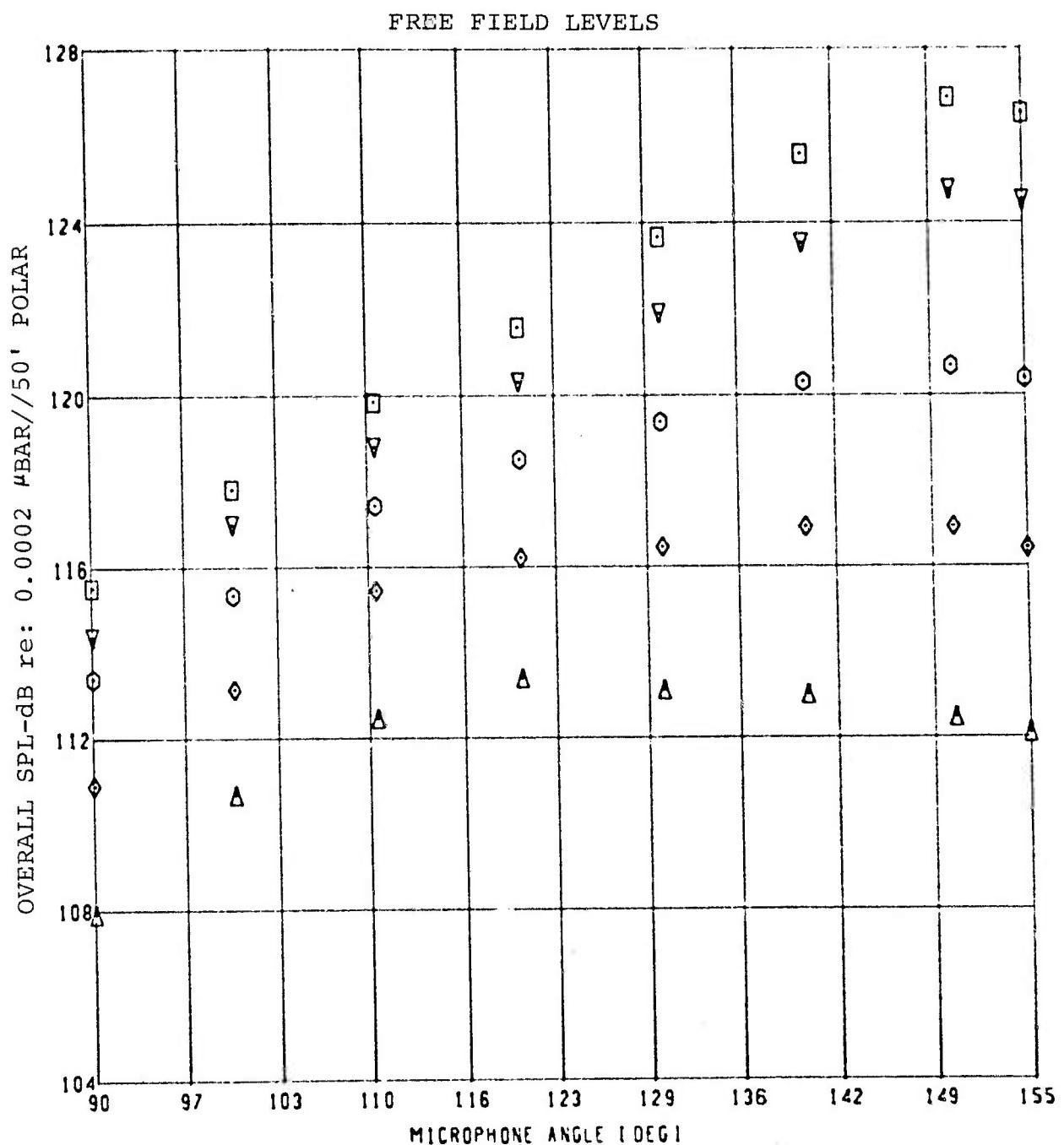


61T-3.1AR-CPA-RT/NC NOZZLE

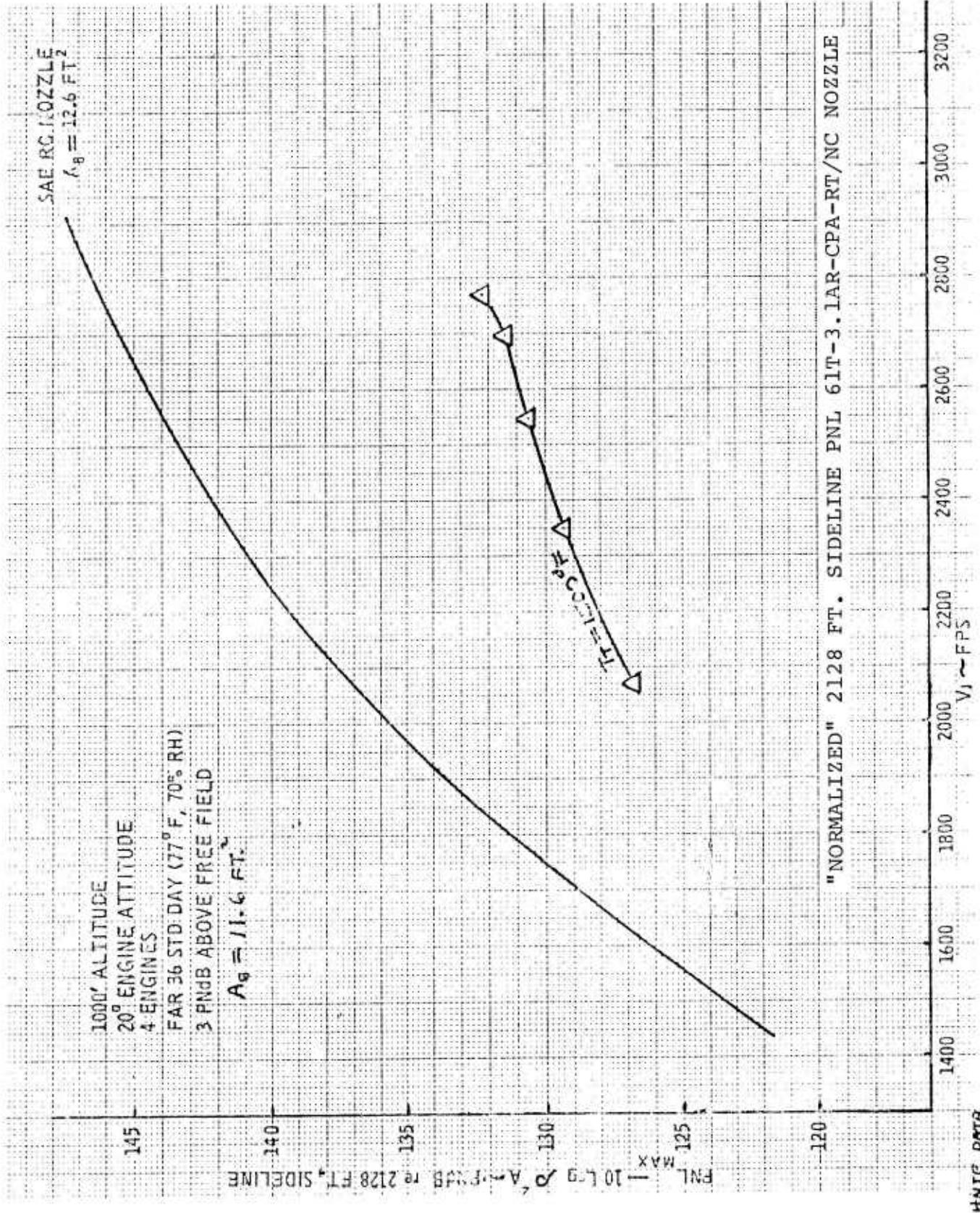


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	GASPL [dB]
○	07G	1500° F	2.000	130	50FP	118.7
□	07G	1500	2.500	130	5CFP	122.1
×	07G	1500	3.000	130	50FP	125.1
*	07G	1500	3.500	130	50FP	127.7
▽	07G	1500	3.800	130	50FP	129.5

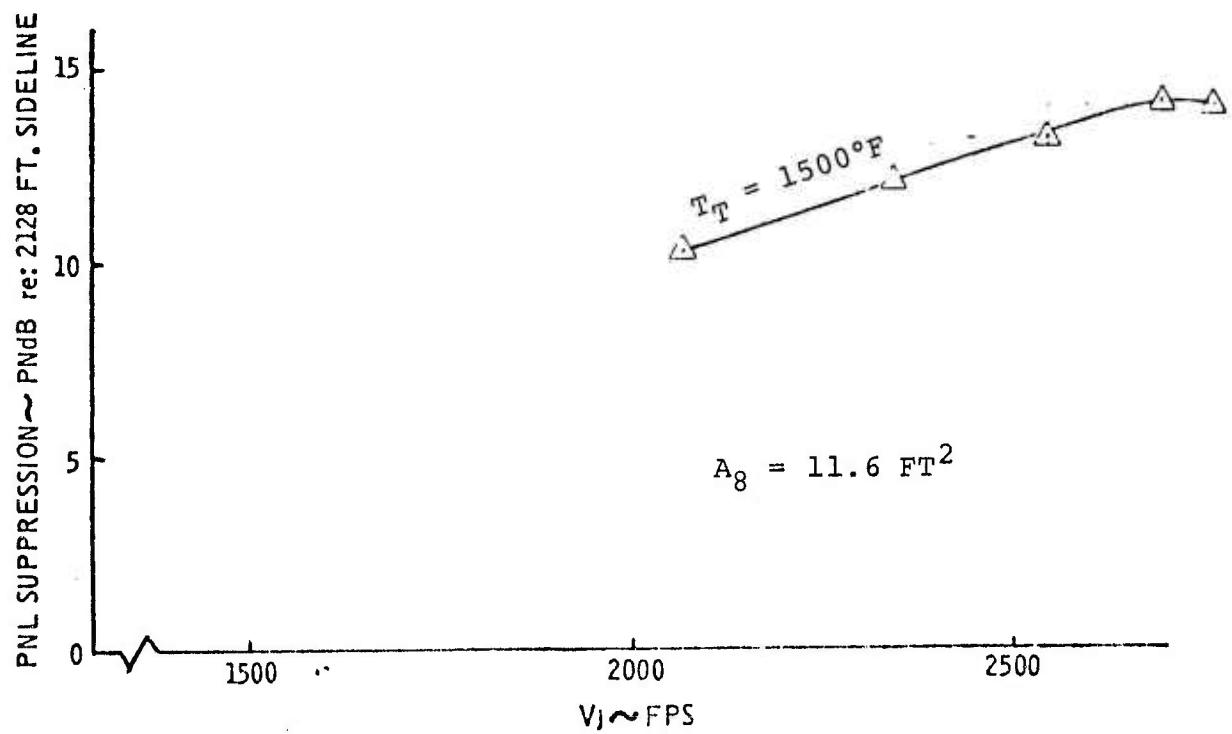
61T-3.1AR-CPA-RT/NC NOZZLE



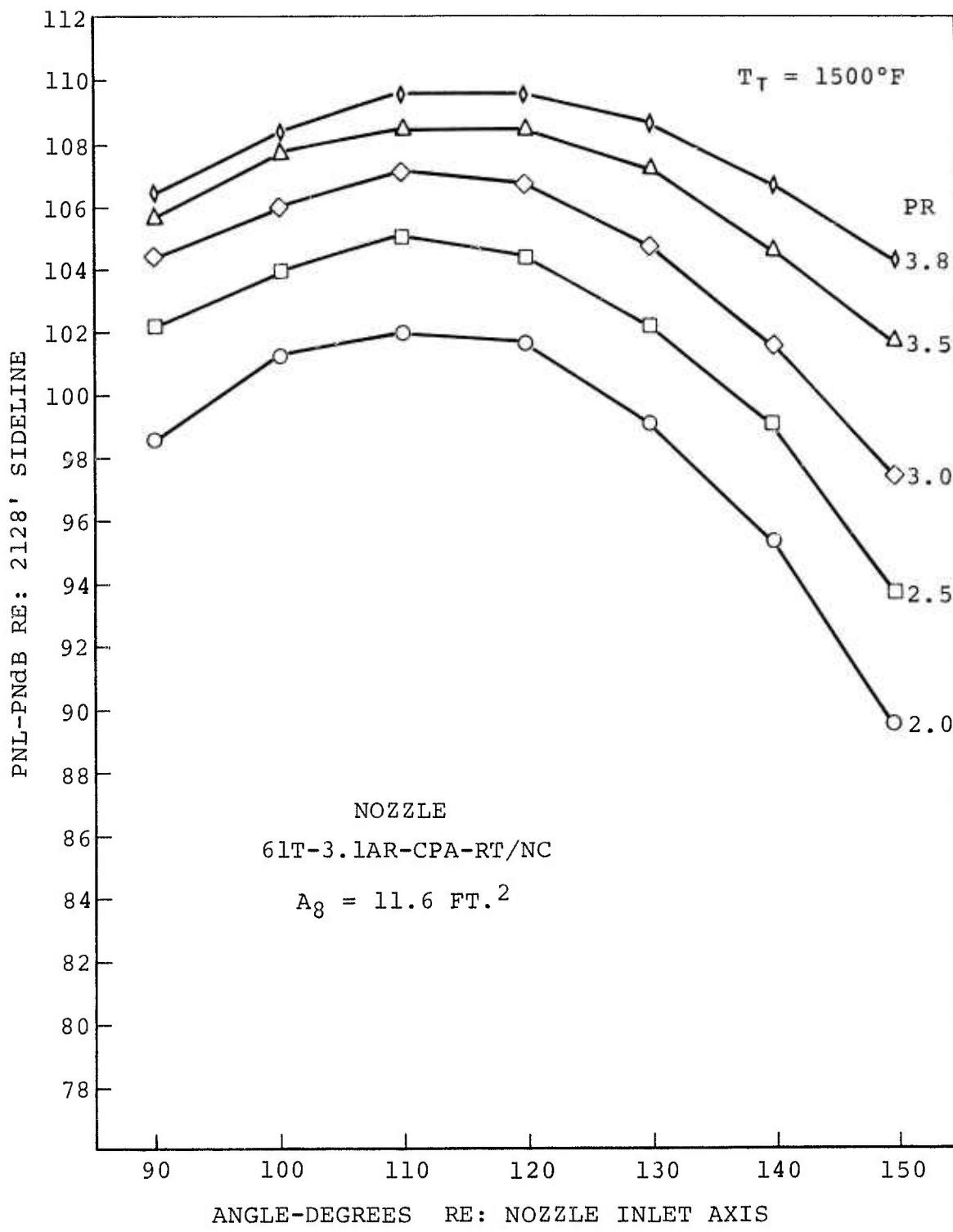
61T-3.1AR-CPA-RT/NC NOZZLE



61T-3.1AR-CPA-RT/NC NOZZLE

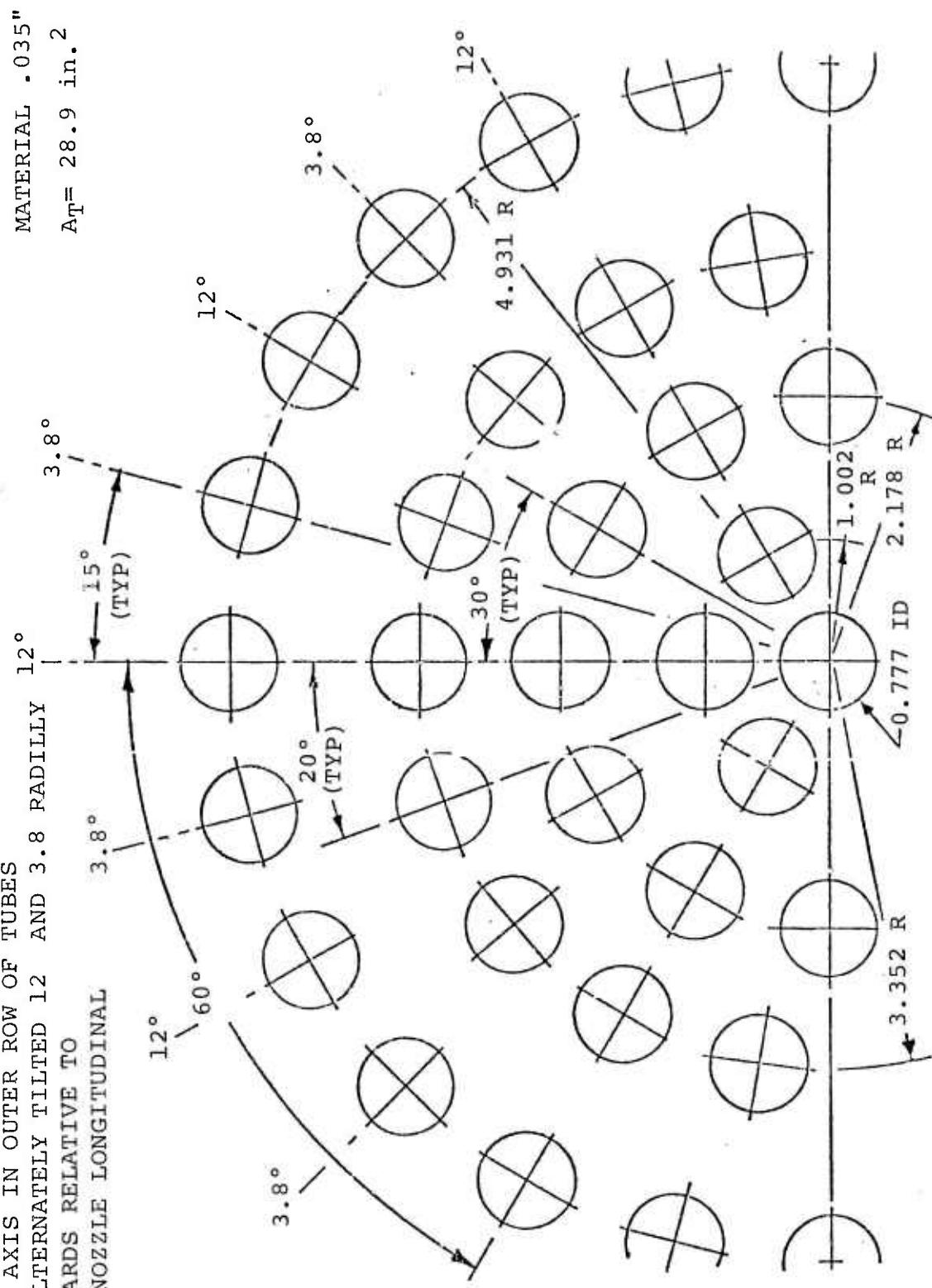


PEAK PNL SUPPRESSION VALUES



61 TUBE 3.1AR NOZZLE PERCEIVED NOISE LEVEL BEAM PATTERN

FLOW AXIS IN OUTER ROW OF TUBES
IS ALTERNATELY TILTED 12° AND 3.8° RADILY
OUTWARDS RELATIVE TO
THE NOZZLE LONGITUDINAL
AXIS



61 TUBE AR 3.07 NOZZLE EXIT FLOW PATTERN (WITH TILTED OUTER ROW OF TUBES)

TEST CONDITIONS

NOZZLE: 61T- (CANTED) - 3.1AR-CPA-RT/NC

FACILITY: HNTF

DATE: 12-3-73

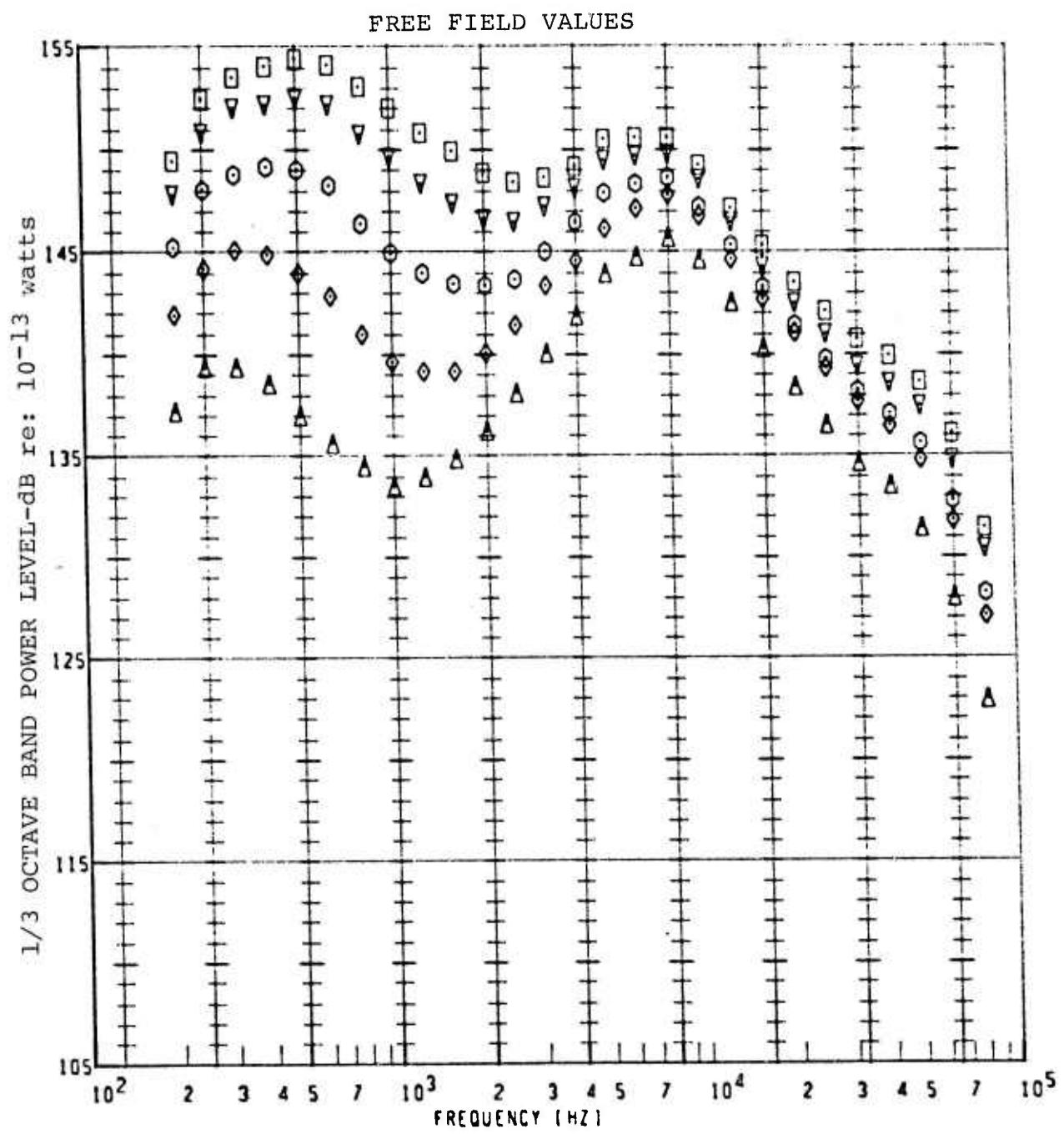
T_{AMB} = 50°F

R.H. = 67%

SCALE MODEL A₈ = 28.9 in.²

RUN NO.	NPR	T_T	V_J (IDEAL)	REMARKS	REF
18	2.0	1500°F	2072 fps	12-3-73	
"	2.5	"	2351	"	
"	3.0	"	2548	"	
"	3.5	"	2697	"	
"	3.8	"	2771	"	

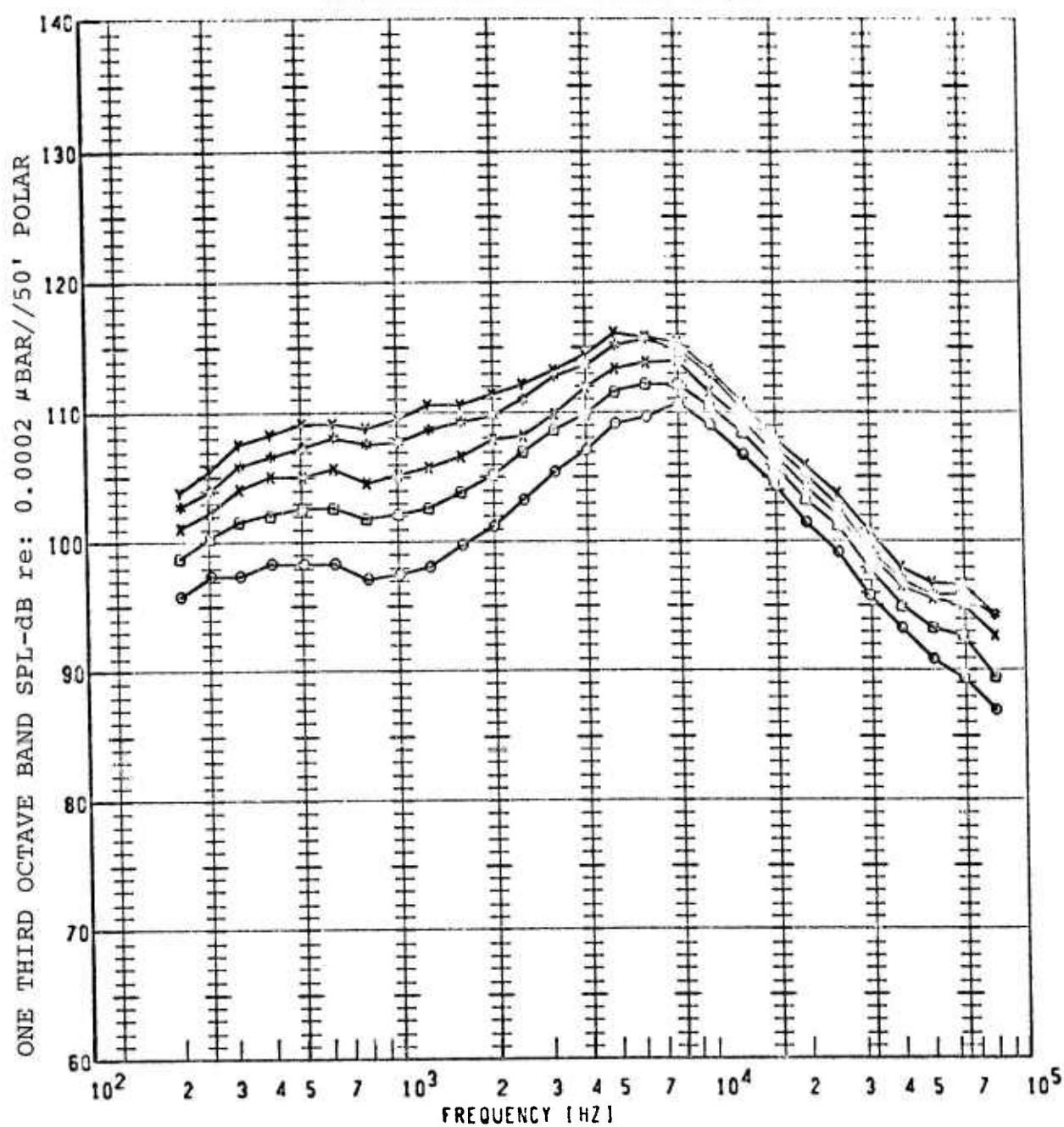
MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.
(HNTF)



PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	18	2.00	1500°F
◊	18	2.50	1500
○	18	3.00	1500
▽	18	3.50	1500
□	18	3.80	1500

61T- (CANTED) - 3.1AR-CPA-RT/NC NOZZLE

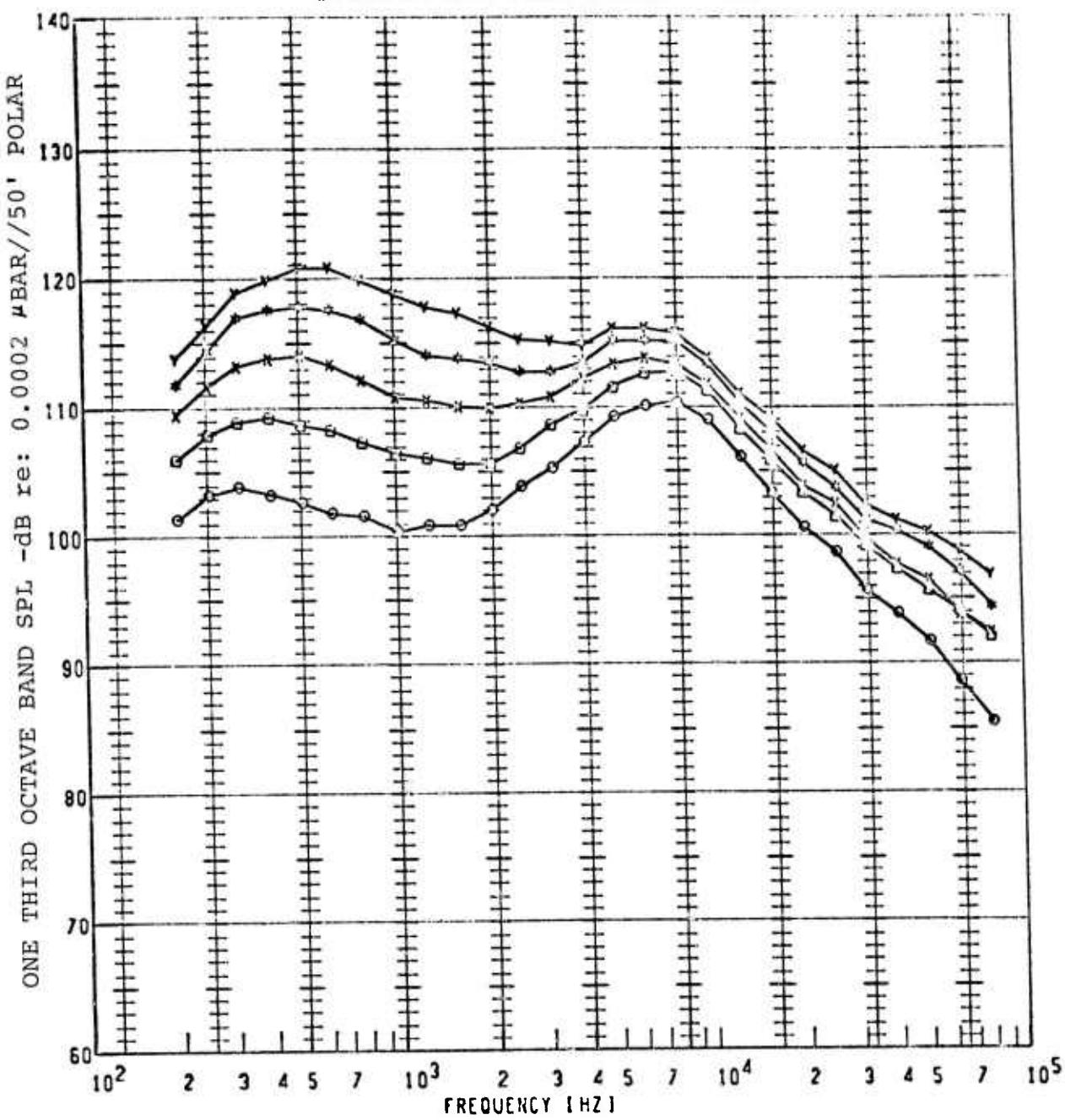
SPECTRA ARE FREE FIELD + 6dB



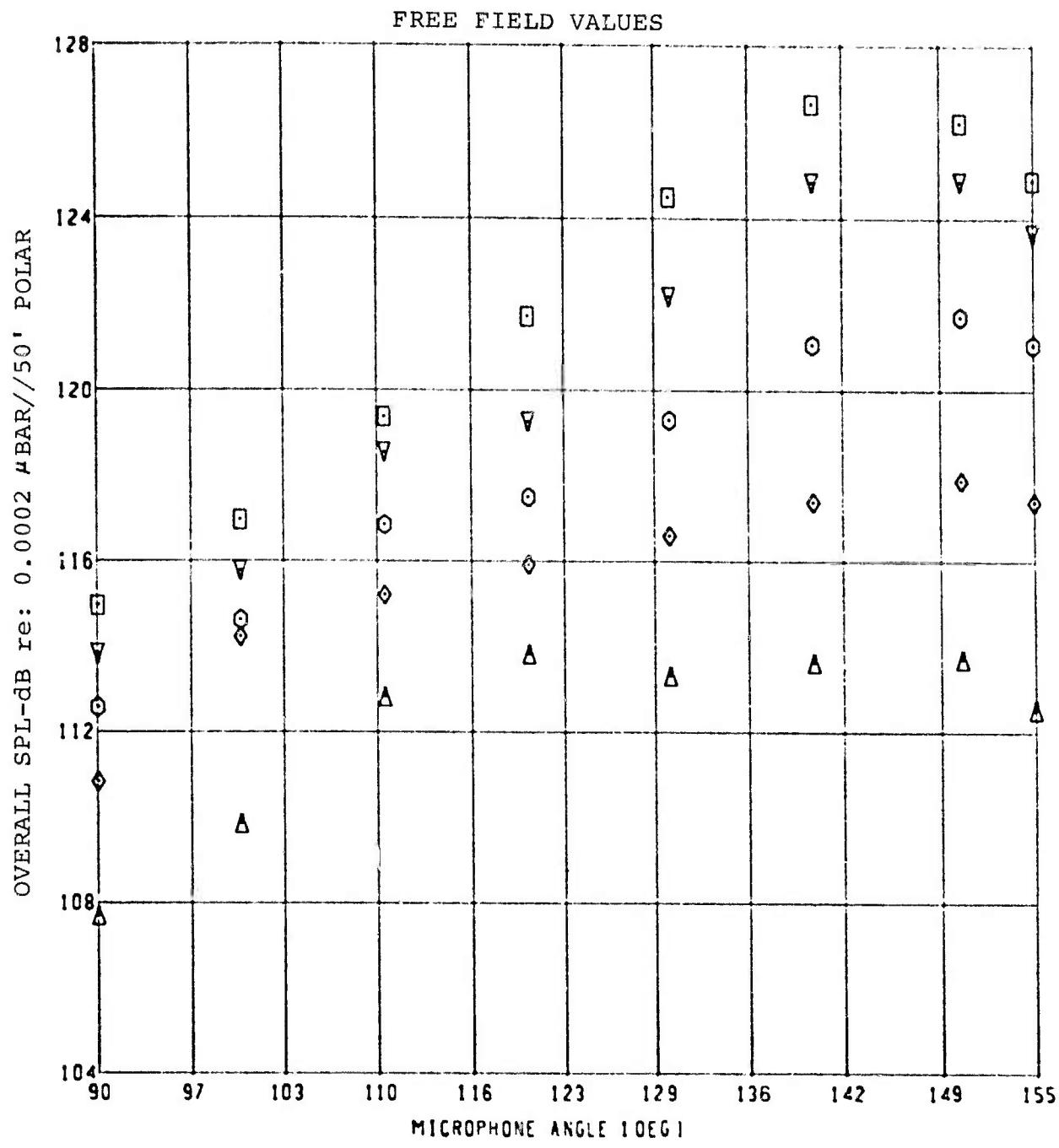
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL [dB]
○	18G	1500° F	2.000	110	50FP	118.2
◎	18G	1500	2.500	110	50FP	120.6
×	18G	1500	3.000	110	50FP	122.4
*	18G	1500	3.500	110	50FP	124.1
Y	18G	1500	3.800	110	50FP	125.0

61T-(CANTED)-3.1AR-CPA-RT/NC NOZZLE

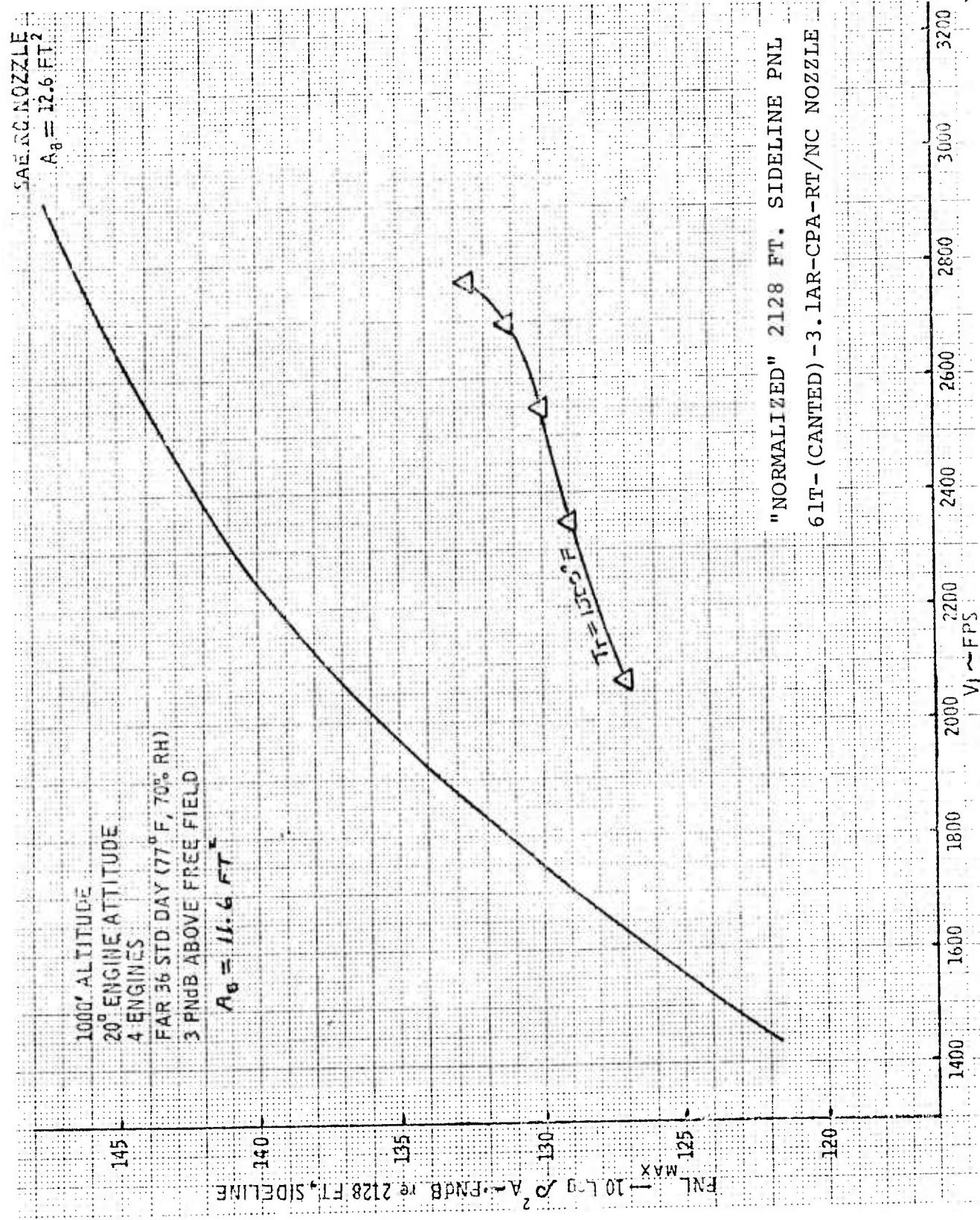
SPECTRA ARE FREE FIELD + 6dB



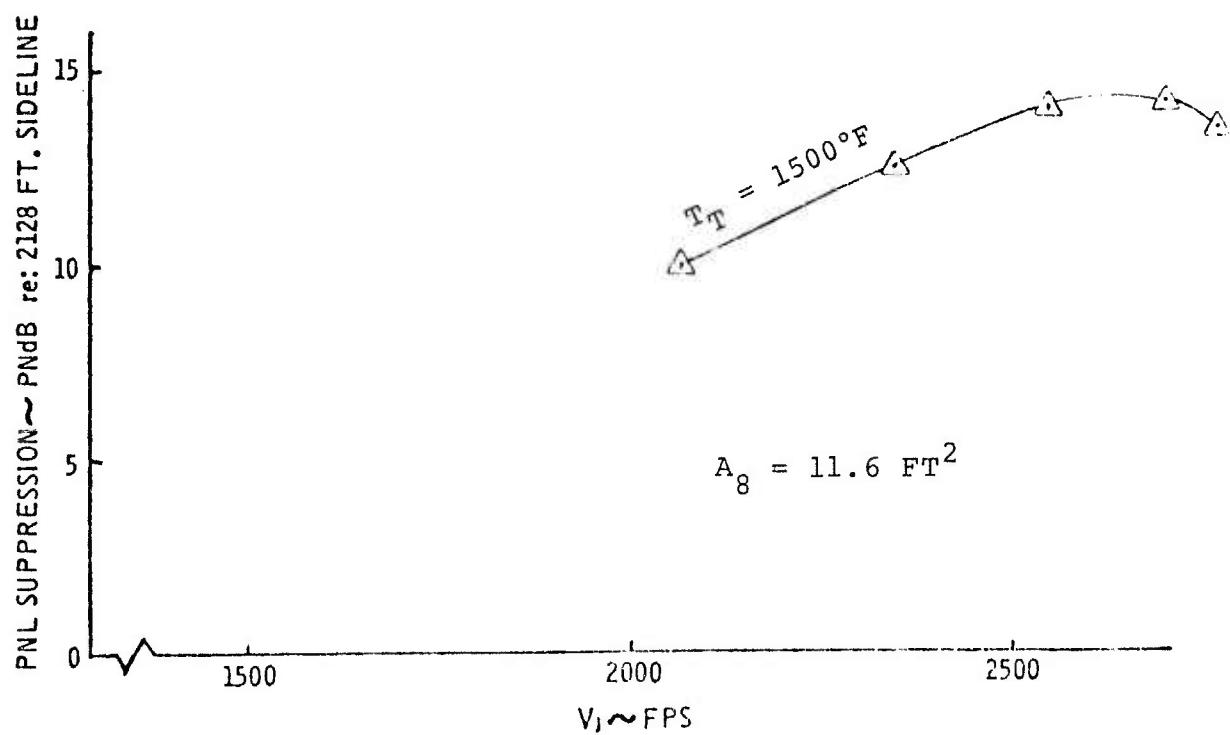
PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	DASPL (100)
○	18G	1500°F	2.000	130	SOFP	118.8
●	18G	1500	2.500	130	SOFP	122.2
x	18G	1500	3.000	130	SOFP	125.0
*	18G	1500	3.500	130	SCFP	128.0
▽	18G	1500	3.800	130	SCFP	130.3



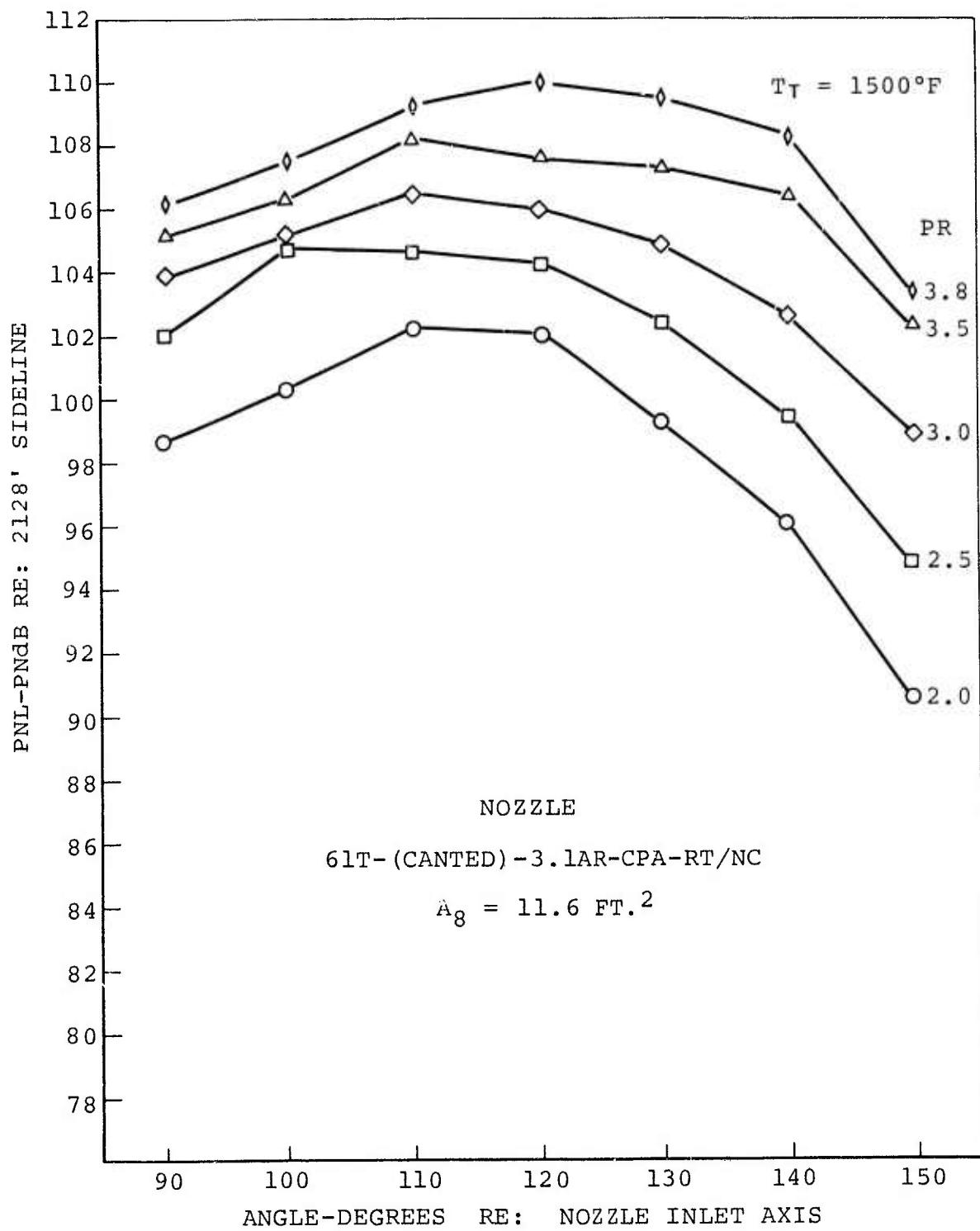
61T- (CANTED) - 3.1AR-CPA-RT/NC NOZZLE



61T- (CANTED) - 3.1AR-CPA-RT/NC NOZZLE



PEAK PNL SUPPRESSION VALUES

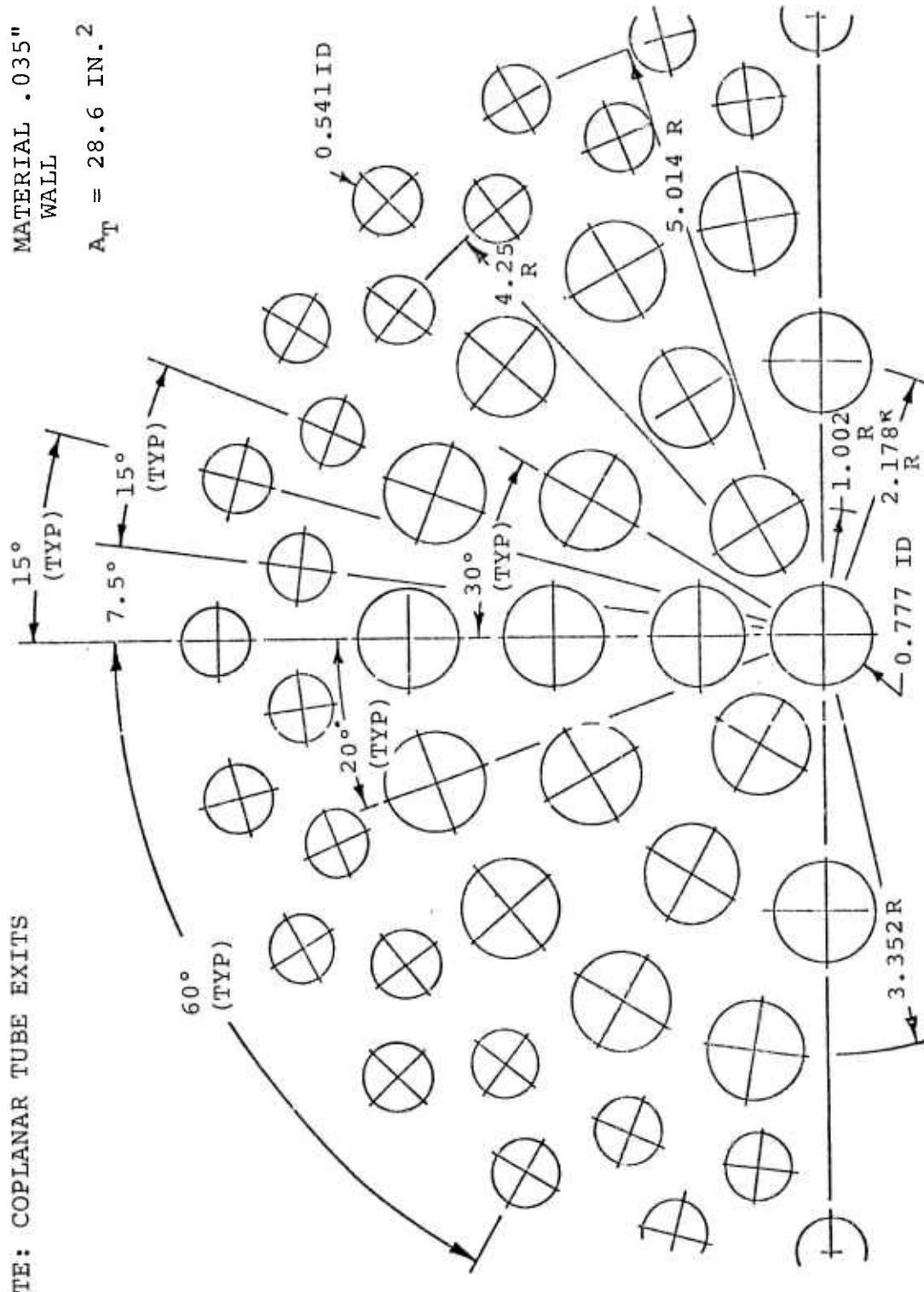


61 TUBE (CANTED) 3.1AR NOZZLE PERCEIVED NOISE LEVEL BEAM PATTERN

NOTE: COPLANAR TUBE EXITS

MATERIAL .035"
WALL

$A_T = 28.6 \text{ IN. }^2$



85 TUBE AR 3.07 NOZZLE EXIT FLOW PATTERN

TEST CONDITIONS

NOZZLE: 85T-3.1AR-CPA-RT/NC

FACILITY: HNTF

DATE: 12-4-73

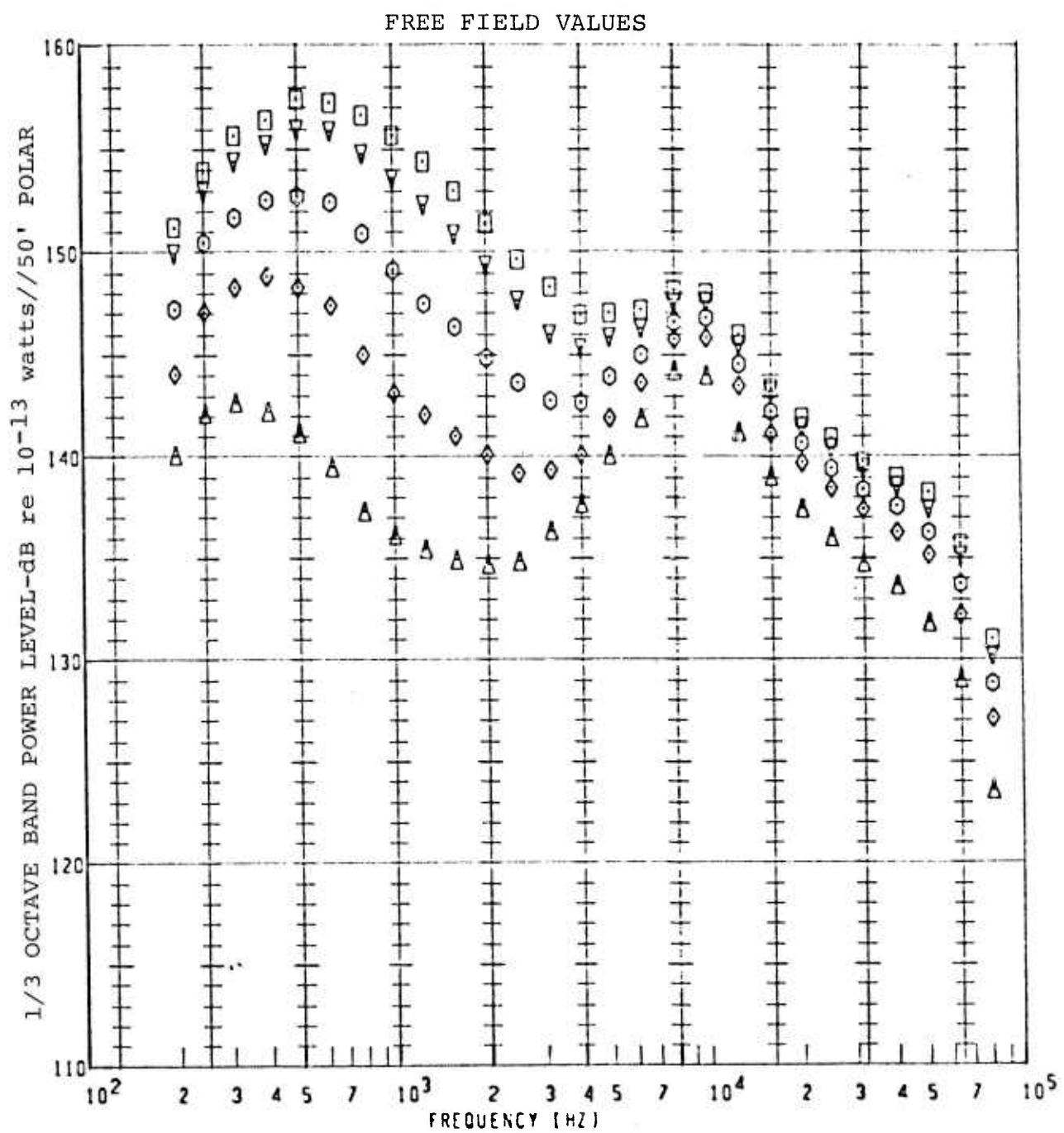
T_{AMB} =

R.H. =

SCALE MODEL A₈ =

<u>RUN NO.</u>	<u>NPR</u>	<u>T_T</u>	<u>V_J (IDEAL)</u>	<u>REMARKS</u>	<u>REF</u>
21	2.0	1500°F	2072 fps	12-4-73	
"	2.5	"	2351	"	
"	3.0	"	2548	"	
"	3.5	"	2697	"	
"	3.8	"	2771	"	

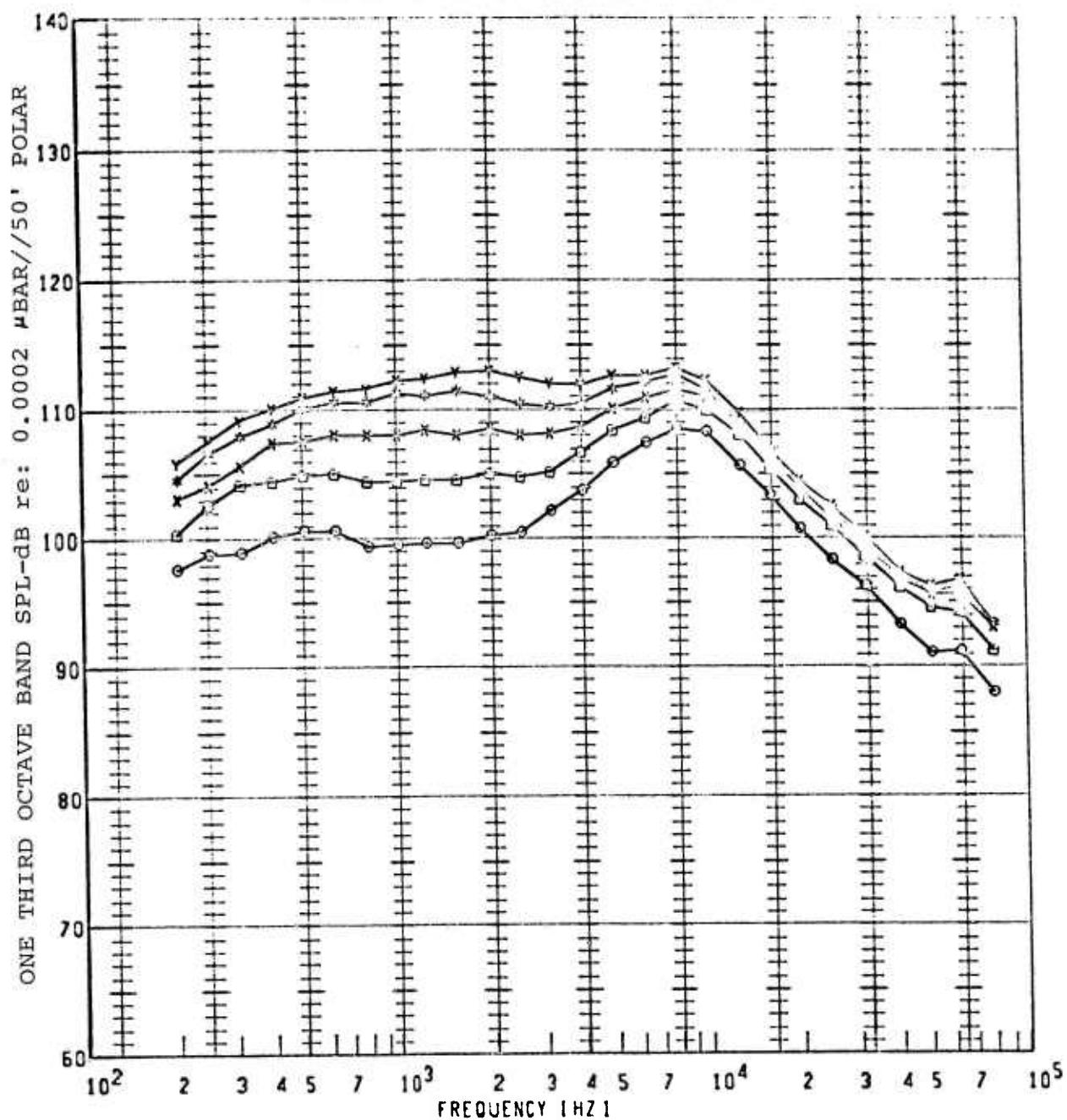
MICROPHONE LAYOUT: 50 FOOT POLAR ARC, MICROPHONES FLUSH WITH CONCRETE GROUND SURFACE. MEASURED ACOUSTIC DATA IS +6 dB RELATIVE TO FREE-FIELD VALUES.



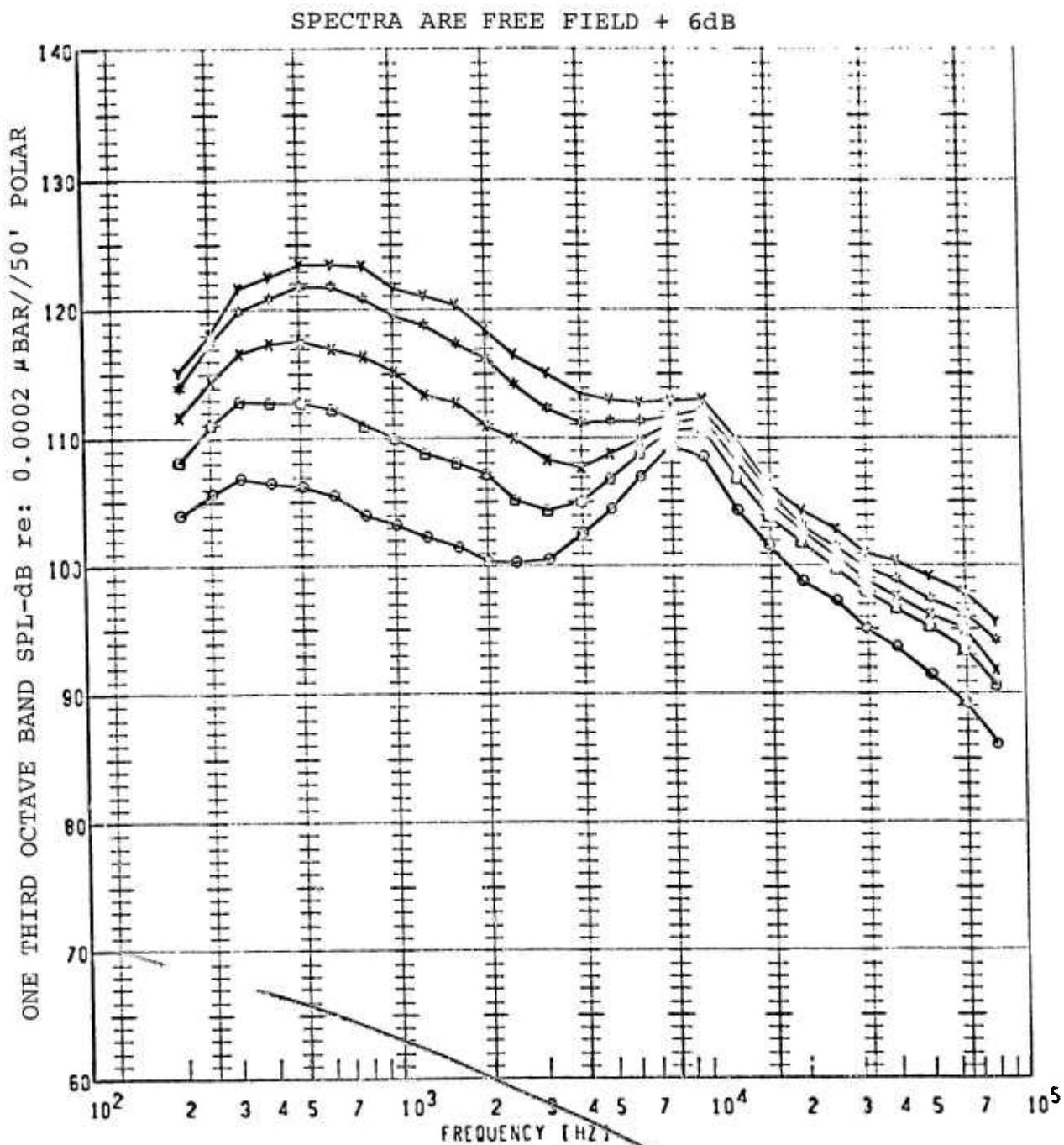
PLOT SYMBOL	RUN NUMBER	PRESSURE RATIO	JET TEMP
△	21	2.00	1500 °F
◊	21	2.50	1500
○	21	3.00	1500
▽	21	3.50	1500
□	21	3.80	1500

85T-3.1AR-CPA-RT/NC NOZZLE

SPECTRA ARE FREE FIELD + 6dB

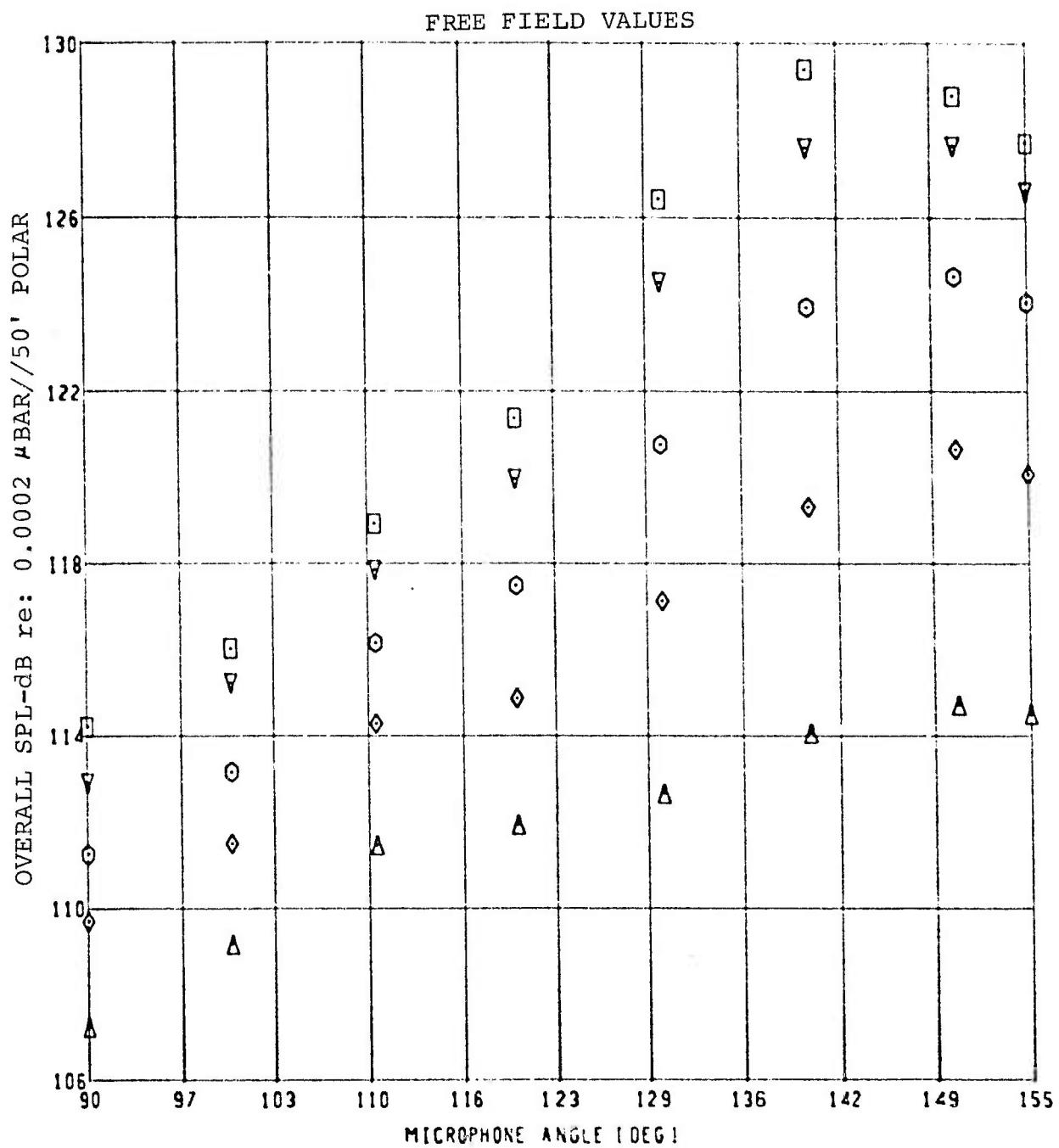


85T-3.1AR-CPA-RT/NC NOZZLE

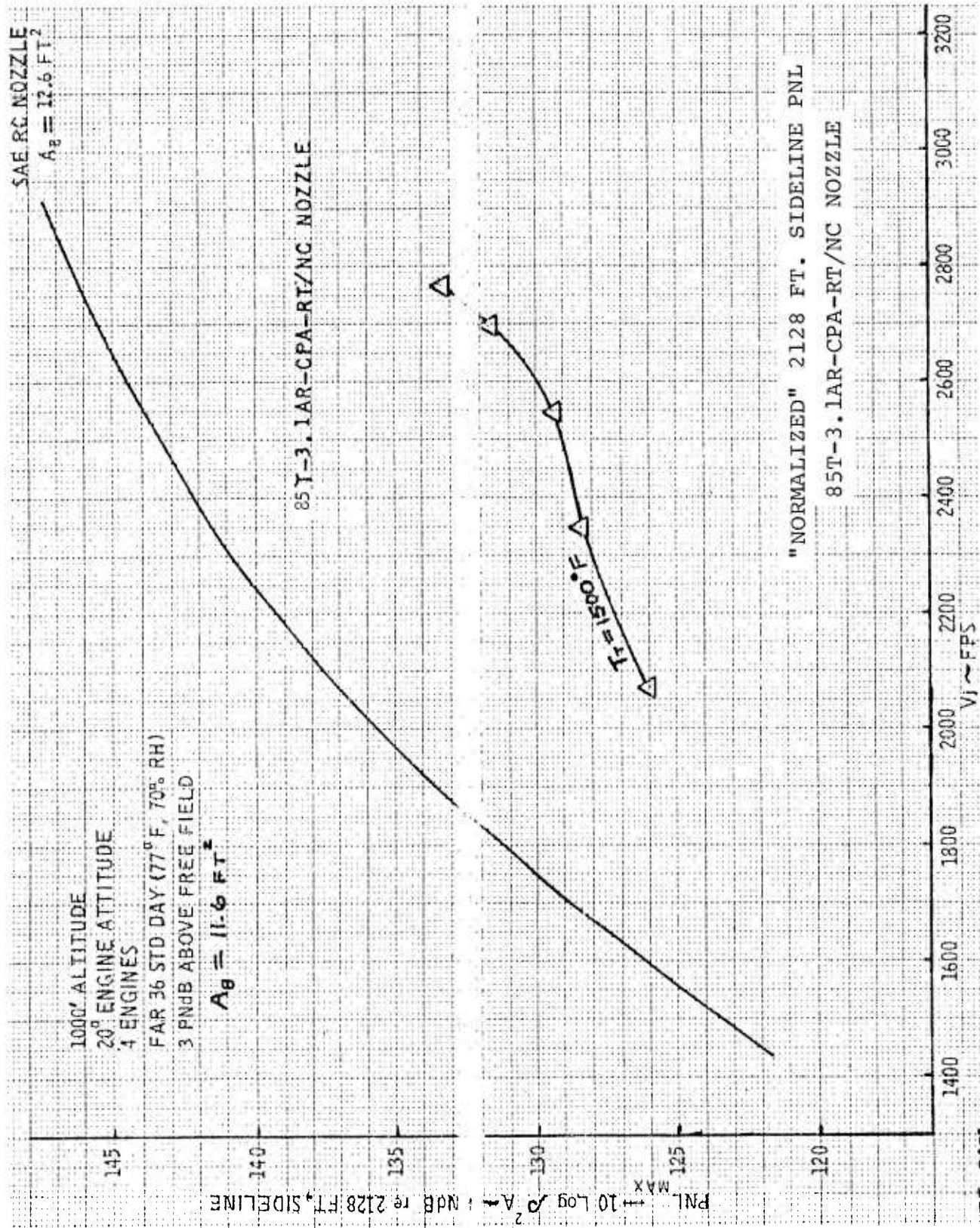


PLOT SYMBOL	RUN NUMBER	JET TEMP	PRESSURE RATIO	ANGLE RE INLET	OBSERVER LOCATION	CASPL 1031
o	21G	1500°F	2.000	130	SOFP	118.2
□	21G	1500	2.500	130	SOFP	122.8
x	21G	1500	3.000	130	SOFP	126.6
*	21G	1500	3.500	130	SCFP	130.5
+	21G	1500	3.800	130	SOFP	132.4

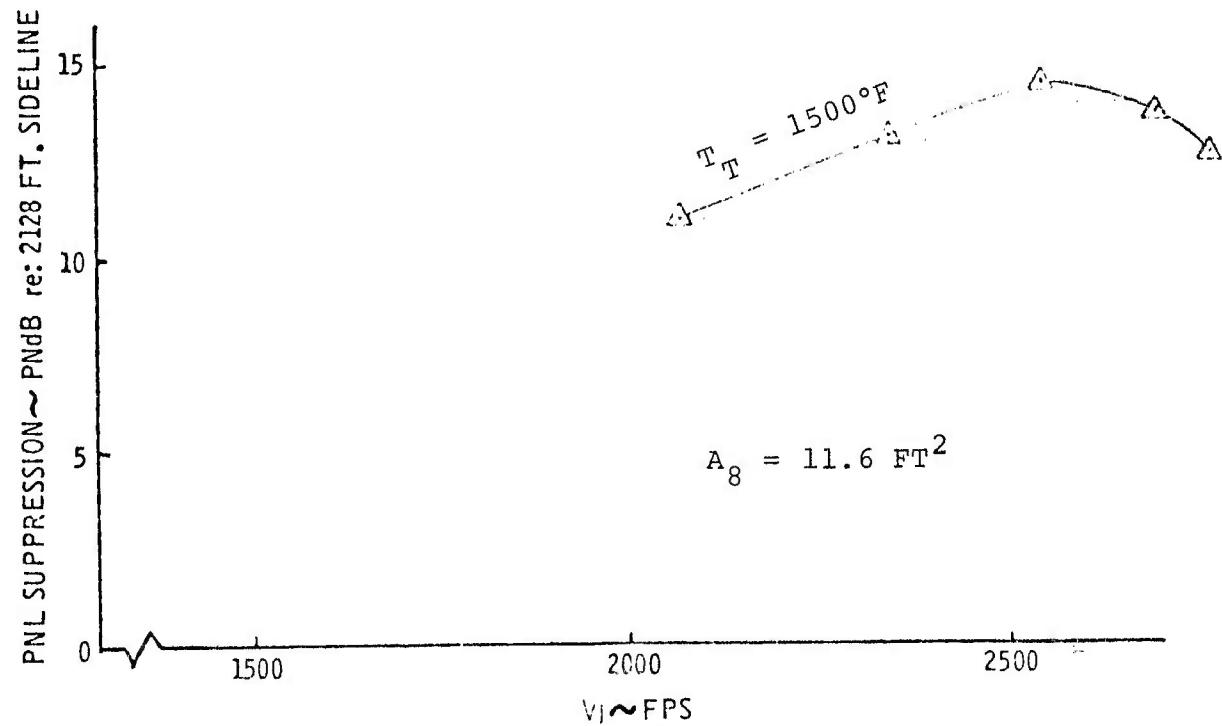
85T-3.1AR-CPA-RT/NC NOZZLE



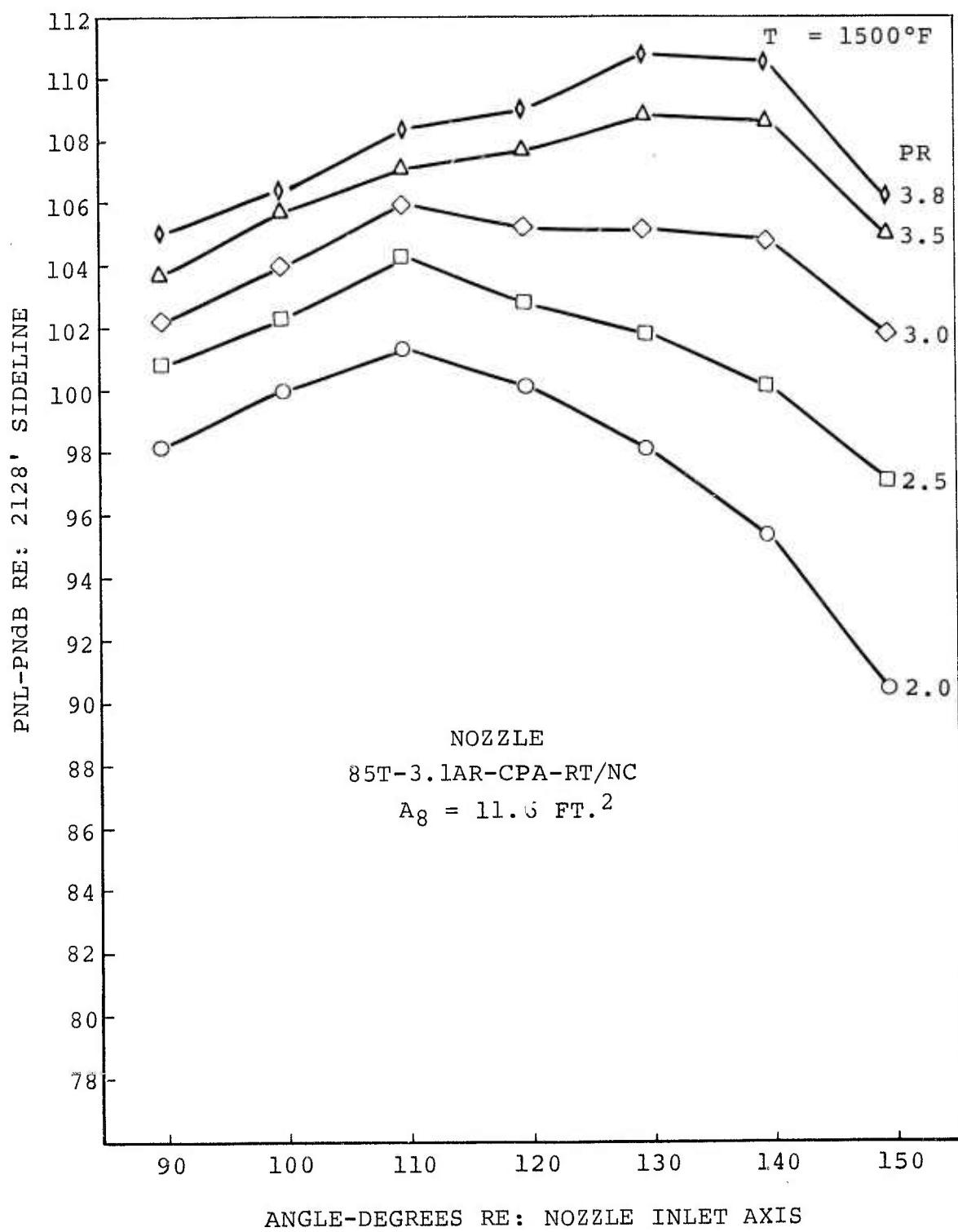
85T-3.lAR-CPA-RT/NC NOZZLE



85 T -3.1AR-CPA-RT/NC NOZZLE



PEAK PNL SUPPRESSION VALUES



85 TUBE 3.1AR NOZZLE PERCEIVED NOISE LEVEL BEAM PATTERN